2. General information

These installation and operating instructions are a supplement to installation and operating instructions for the corresponding standard pumps CR, CRI, CRN, CRK, SPK, MTR. For instructions not mentioned specifically here, please see installation and operating instructions for the standard pump.

2.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

2.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

2.3 General description

Grundfos E-pumps have standard motors with integrated frequency converter. The pumps are for single-phase or three-phase power supply connection.

2.3.1 Pumps without factory-fitted sensor

The pumps have a built-in PI controller and can be set up for an external sensor enabling control of the following parameters:

- pressure
- differential pressure
- temperature
- differential temperature
- flow rate
- liquid level in a tank.

From factory, the pumps have been set to control mode uncontrolled. The PI controller can be activated by means of R100.

2.3.2 Pumps with pressure sensor

The pumps have a built-in PI controller and are set up with a pressure sensor enabling control of the pump discharge pressure.

The pumps are set to control mode controlled. The pumps are typically used to hold a constant pressure in variable-demand systems.

2.3.3 Settings

The description of settings apply both to pumps without factory-fitted sensor and to pumps with a factory-fitted pressure sensor.

Setpoint

The desired setpoint can be set in three different ways:

- directly on the pump control panel
- via an input for external setpoint signal
- by means of Grundfos wireless remote control R100.

Other settings

All other settings can only be made by means of the R100.

Important parameters such as actual value of control parameter, power consumption, etc. can be read via the R100.

If special or customized settings are required, use Grundfos PC Tool E-products. Contact your local Grundfos company for more information.

3. Installing the product

3.1 Mechanical installation

The pump must be secured to a solid foundation by means of bolts through the holes in the flange or baseplate.

In order to retain the UL/cUL approval, follow the additional installation procedures found in the *Appendix*.

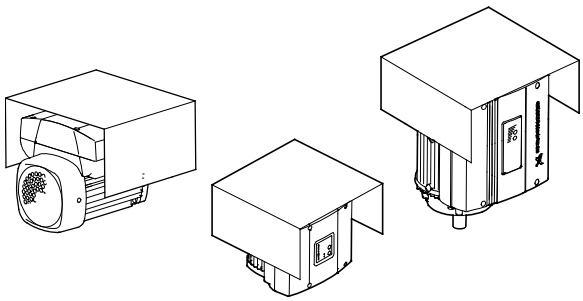
3.1.1 Motor cooling

To ensure sufficient cooling of motor and electronics, observe the following requirements:

- Make sure that sufficient cooling air is available.
- Keep the temperature of the cooling air below 104 °F (40 °C).
- Keep cooling fins and fan blades clean.

3.2 Outdoor installation

When installed outdoors, the pump must be provided with a suitable cover to avoid condensation on the electronic components. See fig. 1.



TM00 8622 0101 - TM02 8514 0304

Fig. 1 Examples of covers

Remove the drain plug pointing downwards in order to avoid moisture and water build-up inside the motor.

Vertically mounted pumps are IP55 after removal of the drain plug. Horizontally mounted pumps change enclosure class to IP54.

In order to retain the UL mark, additional requirements apply to the equipment. See *Appendix*.

3.3 Electrical connection

For description of how to connect E-pumps electrically, see the following pages:

3.4 Three-phase pumps, 20-30 hp, page 5.

3.4 Three-phase pumps, 20-30 hp

DANGER

Electric shock

Death or serious personal injury

- The user or the installer is responsible for the installation of correct grounding and protection according to current national and local standards. All operations must be carried out by qualified personnel.

DANGER

Electric shock

Death or serious personal injury

- Never make any connections in the pump terminal box unless all electric supply circuits have been switched off for at least 5 minutes.
- Note for instance that the signal relay may be connected to an external supply which is still connected when the power supply is disconnected.

WARNING

Hot surface

Death or serious personal injury

- The surface of the terminal box may be above 158 °F (70 °C) when the pump is operating.

3.4.1 Preparation

Before connecting the E-pump to the power supply, take the issues illustrated in the figure below into consideration.

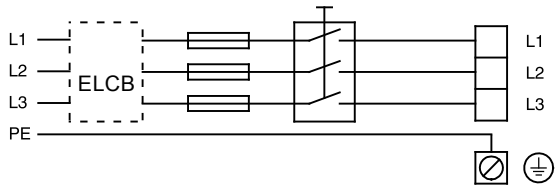


Fig. 2 Power supply-connected pump with power switch, backup fuses, additional protection and protective grounding

3.4.2 Protection against electric shock - indirect contact

DANGER

Electric Shock

Death or serious personal injury

- The pump must be grounded in accordance with national regulations.
- As the leakage current of 20-30 hp motors is > 10 mA, take extra precautions when grounding these motors.

EN 61800-5-1 specifies that the pump must be stationary and installed permanently when the leakage current is > 10 mA.

One of the following requirements must be fulfilled:

- A single protective ground lead (7 AWG minimum copper)

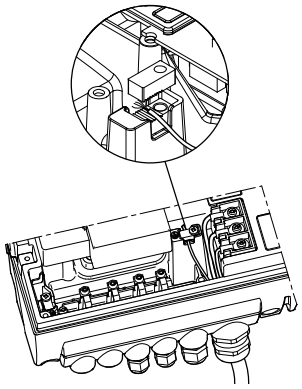


Fig. 3 Connection of a single protective ground lead using one of the leads of a 4-core power cable (7 AWG minimum)

- Two protective ground leads of the same cross-sectional area as the power supply leads, with one lead connected to an additional ground terminal in the terminal box.

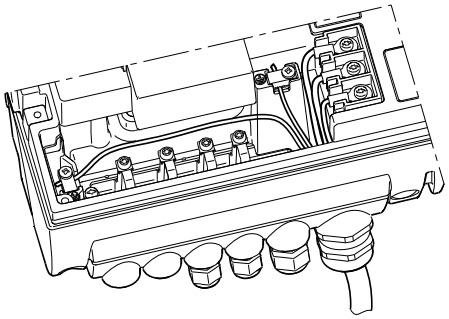


Fig. 4 Connection of two protective ground leads using two of the leads of a 5-core power supply cable

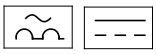
Protective ground leads must always have a yellow/green (PE) or yellow/green/blue (PEN) color marking.

3.4.3 Backup fuses

For recommended fuse sizes, see section *8.1.1 Supply voltage*.

3.4.4 Additional protection

If the pump is connected to an electric installation where an ground leakage circuit breaker (ELCB) is used as additional protection, the circuit breaker must be of a type marked with the following symbols:


ELCB

This circuit breaker is **type B.**

The total leakage current of all the electrical equipment in the installation must be taken into account.

For leakage current of the motor in normal operation, see section *8.1.3 Leakage current.*

During start and at asymmetrical supply systems, the leakage current can be higher than normal and may cause the ELCB to trip.

3.4.5 Motor protection

The pump requires no external motor protection. The motor incorporates thermal protection against slow overloading and blocking (IEC 34-11, TP 211).

3.4.6 Protection against voltage transients

The pump is protected against voltage transients in accordance with EN 61800-3 and is capable of withstanding a VDE 0160 pulse.

The pump has a replaceable varistor which is part of the transient protection.

Over time this varistor will be worn and need to be replaced. When the time for replacement has come, R100 and PC Tool E-products will indicate this as a warning. See section *7. Servicing the product.*

3.4.7 Supply voltage

3 x 460-480 V - 10 %/+ 10 %, 50/60 Hz, PE.

The supply voltage and frequency are marked on the pump nameplate. Make sure that the motor is suitable for the power supply of the installation site.

The wires in the terminal box must be as short as possible. Excepted from this is the protective ground lead which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.

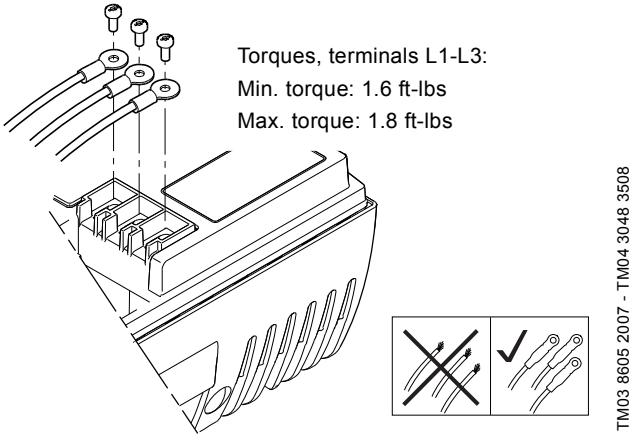


Fig. 5 Power connection

Cable glands

Cable glands comply with EN 50626.

- 1 x M40 cable gland
- 1 x M20 cable gland
- 2 x M16 cable gland
- 2 x M16 knock-out cable entries.

If the supply cable is damaged, it must be replaced by qualified personnel.

Grid types

Three-phase E-pumps can be connected to all grid types.

Could result in personal injury

– Do not connect three-phase E-pumps to a power supply with a voltage between phase and ground of more than 440 V.

3.4.8 Start/stop of pump

The number of starts and stops via the power supply must not exceed 4 times per hour.

When the pump is switched on via the power supply, it will start after approx. 5 seconds.

If a higher number of starts and stops is desired, use the input for external start/stop when starting/stopping the pump.

When the pump is switched on via an external on/off switch, it will start immediately.

3.4.9 Connections

If no external on-off switch is connected, connect terminals 2 and 3 using a short wire.

As a precaution, the wires to be connected to the following connection groups must be separated from each other by reinforced insulation in their entire lengths:

Group 1: Inputs

- start/stop terminals 2 and 3
- digital input terminals 1 and 9
- setpoint input terminals 4, 5 and 6
- sensor input terminals 7 and 8
- GENIbus terminals B, Y and A

All inputs (group 1) are internally separated from the power-conducting parts by reinforced insulation and galvanically separated from other circuits.

All control terminals are supplied with protective extra-low voltage (PELV), thus ensuring protection against electric shock.

Group 2: Output (relay signal, terminals NC, C, NO)

The output (group 2) is galvanically separated from other circuits. Therefore, the supply voltage or protective extra-low voltage can be connected to the output as desired.

Group 3: Power supply (terminals L1, L2, L3)

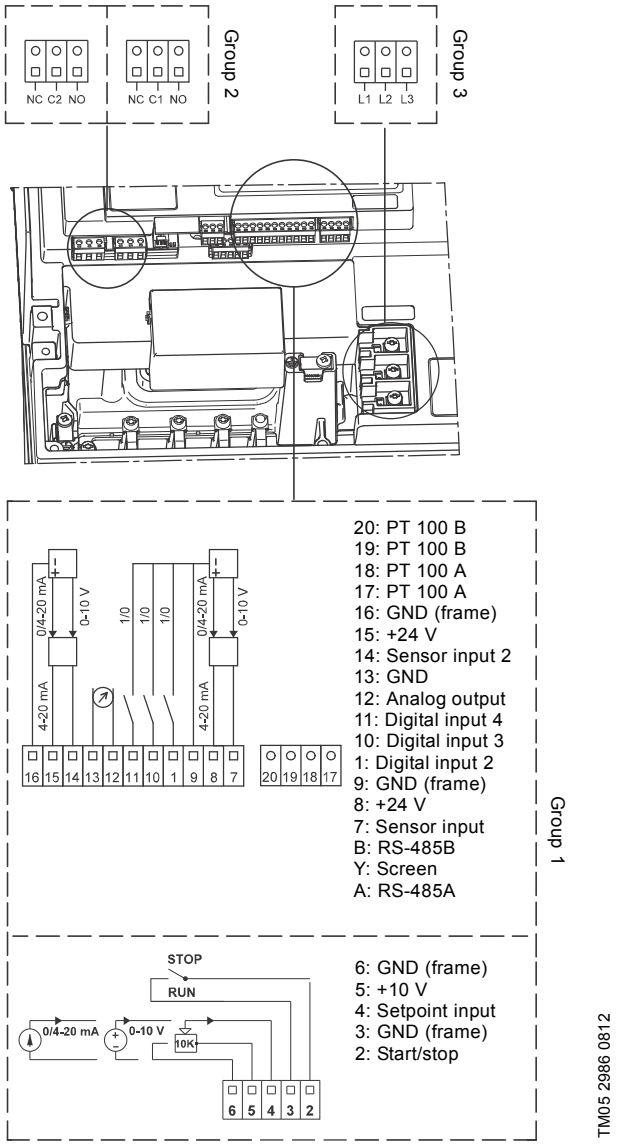


Fig. 6 Connection terminals

A galvanic separation must fulfill the requirements for reinforced insulation including creepage distances and clearances specified in EN 61800-5-1.

3.4.10 Signal cables

- Use screened cables with a conductor cross-section of min. 28 AWG and max. 16 AWG for external on/off switch, digital input, setpoint and sensor signals.
- Connect the screens of the cables to frame at both ends with good frame connection. The screens must be as close as possible to the terminals. See fig. 7.

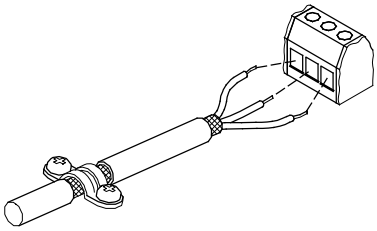


Fig. 7 Stripped cable with screen and wire connection

- Always tighten screws for frame connections whether a cable is fitted or not.
- Make the wires in the pump terminal box as short as possible.

3.5 E-pump electrical connections

3.5.1 Connection of E-pump to Danfoss pressure sensor MBS3000

The blue wire of the pressure sensor is connected to the #7 terminal of the E-pump. The brown wire of the pressure sensor is connected to the #8 terminal of the E-pump.

See section *3.4.10 Signal cables* for additional details.

Fig. 8 Danfoss pressure sensor

3.5.2 Connection of E-pump to LiqTec®

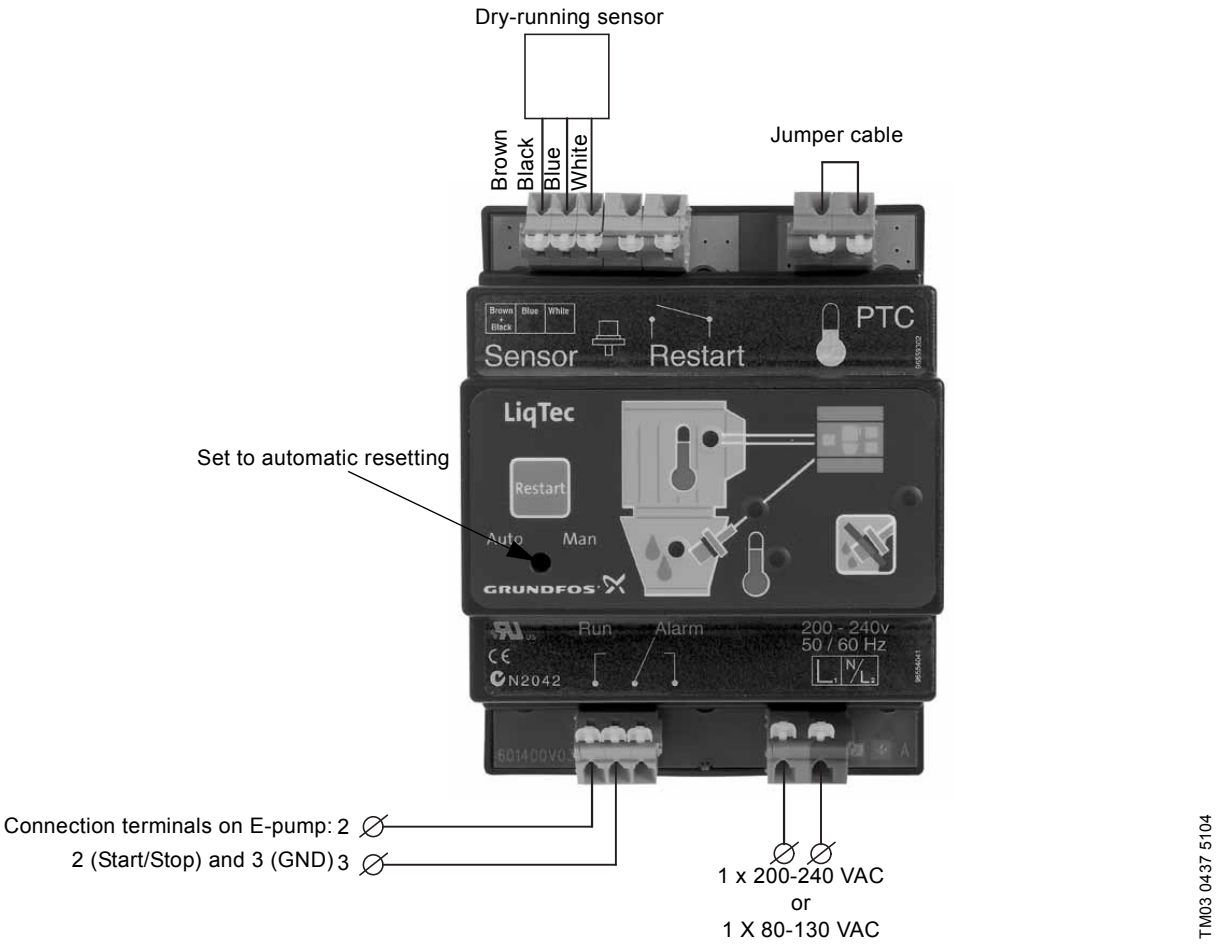


Fig. 9 Connection of E-pump to LiqTec

3.6 Bus connection cable

3.6.1 New installations

For the bus connection, use a screened 3-core cable with a conductor cross-section of 28-16 AWG.

- If the pump is connected to a unit with a cable clamp which is identical to the one on the pump, connect the screen to this cable clamp.
- If the unit has no cable clamp as shown in fig. 10, leave the screen unconnected at this end.

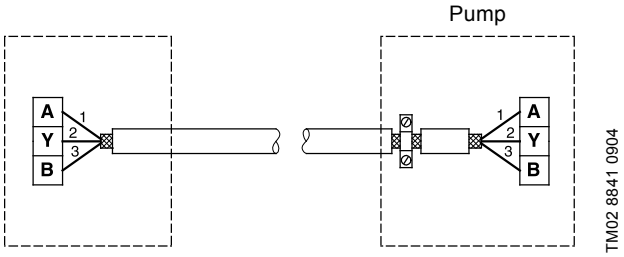


Fig. 10 Connection with screened 3-core cable

3.6.2 Replacing an existing pump

- If a screened 2-core cable is used in the existing installation, connect it as shown in fig. 11.

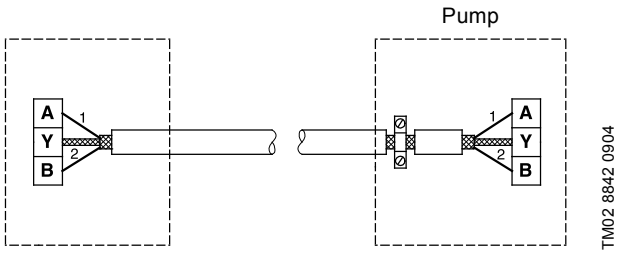


Fig. 11 Connection with screened 2-core cable

- If a screened 3-core cable is used in the existing installation, follow the instructions in section *3.6.1 New installations.*

3.7 Modes

Grundfos E-pumps are set and controlled according to operating and control modes.

3.7.1 Overview of modes

Operating modes	Normal	– Stop	— Min. —	Max.
Control modes	Uncontrolled	– Controlled		
	Constant curve	Constant pressure[1)]		

[1)] For this control mode the pump is equipped with a pressure sensor. The pump may also be equipped with a temperature sensor in which case the description would be constant temperature in control mode controlled.

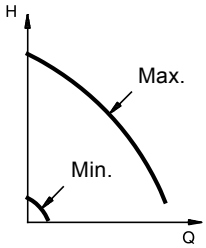
3.7.2 Operating mode

When the operating mode is set to Normal, the control mode can be set to controlled or uncontrolled. See section *3.7.3 Control mode*.

The other operating modes that can be selected are Stop, Min. or Max.

- Stop: the pump has been stopped
- Min: the pump is operating at its minimum speed
- Max: the pump is operating at its maximum speed.

Figure 12 is a schematic illustration of min. and max. curves.



TM00 5547 0995

Fig. 12 Min. and max. curves

The max. curve can for instance be used in connection with the venting procedure during installation.

The min. curve can be used in periods in which a minimum flow is required.

If the power supply to the pump is disconnected, the mode setting will be stored.

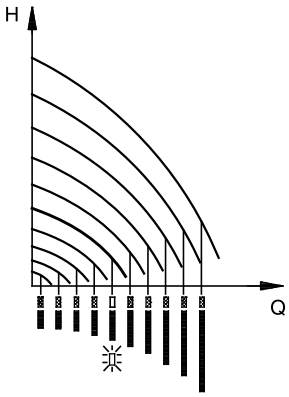
The remote control R100 offers additional possibilities of setting and status displays. See section *5.5 Setting by means of R100*.

3.7.3 Control mode

Pumps without factory-fitted sensor

The pumps are factory-set to control mode **uncontrolled**.

In control mode uncontrolled, the pump will operate according to the constant curve set, fig. 13.



TM00 7746 1304

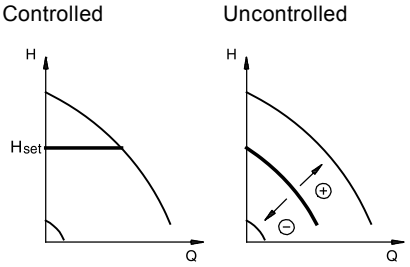
Fig. 13 Pump in control mode **uncontrolled** (constant curve)

3.7.4 Pumps with pressure sensor

The pump can be set to one of two control modes, i.e. controlled and uncontrolled, fig. 14.

In control mode **controlled**, the pump will adjust its performance, i.e. pump discharge pressure, to the desired setpoint for the control parameter.

In control mode **uncontrolled**, the pump will operate according to the constant curve set.



TM00 7668 0404

Fig. 14 Pump in control mode **controlled** (constant pressure) or **uncontrolled** (constant curve)

4. Control functions

4.1 Displays in general

In the following explanation of the functions, one or two displays are shown.

One display

Pumps without or with factory-fitted sensor have the same function.

Two displays

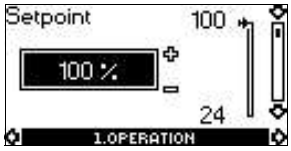
Pumps without or with factory-fitted pressure sensor have different functions and factory settings.

4.2 Menu OPERATION

The first display in this menu is this:

4.2.1 Setpoint

Without sensor (uncontrolled)



- Setpoint set
- Actual setpoint
- Actual value

Set the setpoint in %.

With pressure sensor (controlled)

- Setpoint set
- Actual setpoint
- Actual value

Set the desired pressure in bar.

In control mode **uncontrolled**, the setpoint is set in % of the maximum performance. The setting range will lie between the min. and max. curves.

In control mode **controlled**, the setting range is equal to the sensor measuring range.

If the pump is connected to an external setpoint signal, the value in this display will be the maximum value of the external setpoint signal. See section *4.8 External setpoint signal.*

Setpoint and external signal

The setpoint cannot be set if the pump is controlled via external signals (Stop, Min. curve or Max. curve). R100 will give this warning: External control!

Check if the pump is stopped via terminals 2-3 (open circuit) or set to min. or max. via terminals 1-3 (closed circuit).

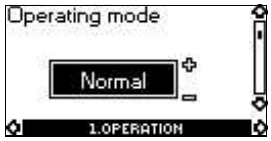
See fig. 23.

Setpoint and bus communication

The setpoint cannot be set either if the pump is controlled from an external control system via bus communication. R100 will give this warning: Bus control!

To override bus communication, disconnect the bus connection. See fig. 23.

4.2.2 Operating mode



Set one of the following operating modes:

- Normal (duty)
- Stop
- Min.
- Max.

The operating modes can be set without changing the setpoint setting.

4.2.3 Fault indications

In E-pumps, faults may result in two types of indication: alarm or warning.

An "alarm" fault will activate an alarm indication in R100 and cause the pump to change operating mode, typically to stop. However, for some faults resulting in alarm, the pump is set to continue operating even if there is an alarm.

A "warning" fault will activate a warning indication in R100, but the pump will not change operating or control mode.

The indication, Warning, only applies to three-phase pumps.

Alarm

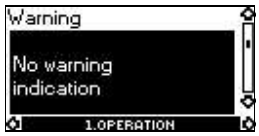
In case of alarm, the cause will appear in this display.

Possible causes:

- No alarm indication
- Too high motor temperature
- Undervoltage
- Mains voltage asymmetry (20-30 hp)
- Overvoltage
- Too many restarts (after faults)
- Overload
- Underload
- Sensor signal outside signal range
- Setpoint signal outside signal range
- External fault
- Duty/standby, Communication fault
- Dry running
- Other fault.

If the pump has been set up to manual restart, an alarm indication can be reset in this display if the cause of the fault has disappeared.

Warning (only three-phase pumps)



In case of warning, the cause will appear in this display.

Possible causes:

- No warning indication.
- Sensor signal outside signal range.
- Relubricate motor bearings, see section *7.2 Relubrication of motor bearings*.
- Replace motor bearings, see section *7.3 Replacement of motor bearings*.
- Replace varistor, see section *7.4 Replacement of varistor (only 20-30 hp).*

A warning indication will disappear automatically once the fault has been remedied.

4.2.4 Fault log

For both fault types, alarm and warning, the R100 has a log function.

Alarm log

In case of "alarm" faults, the last five alarm indications will appear in the alarm log. "Alarm log 1" shows the latest fault, "Alarm log 2" shows the latest fault but one, etc.

The example above gives this information:

- the alarm indication Undervoltage
- the fault code (73)
- the number of minutes the pump has been connected to the power supply after the fault occurred, 8 min.

Warning log

In case of "warning" faults, the last five warning indications will appear in the warning log. "Warning log 1" shows the latest fault, "Warning log 2" shows the latest fault but one, etc.

The example above gives this information:

- the warning indication Relubricate motor bearings
- the fault code (240)
- the number of minutes the pump has been connected to the power supply since the fault occurred, 30 min.

4.3 Menu STATUS

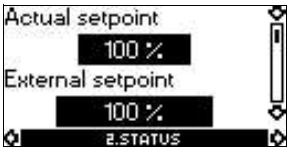
The displays appearing in this menu are status displays only. It is not possible to change or set values.

The displayed values are the values that applied when the last communication between the pump and the R100 took place. If a status value is to be updated, point the R100 at the control panel and press "OK". If a parameter, e.g. speed, should be called up continuously, press "OK" constantly during the period in which the parameter in question should be monitored.

The tolerance of the displayed value is stated under each display. The tolerances are stated as a guide in % of the maximum values of the parameters.

4.3.1 Actual setpoint

Without sensor (uncontrolled)



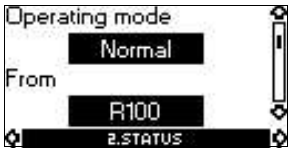
Tolerance: ± 2 %.

With pressure sensor (controlled)

Tolerance: ± 2 %.

This display shows the actual setpoint and the external setpoint in % of the range from minimum value to the setpoint set. See section *4.8 External setpoint signal.*

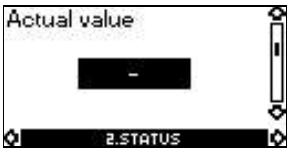
4.3.2 Operating mode



This display shows the actual operating mode (Normal (duty), Stop, Min., or Max.). Furthermore, it shows where this operating mode was selected (R100, Pump, Bus, External or Stop func.). For further details about the stop function (Stop func.), see section *4.4.8 Stop function.*

4.3.3 Actual value

Without sensor (uncontrolled)



With pressure sensor (controlled)

This display shows the value actually measured by a connected sensor.

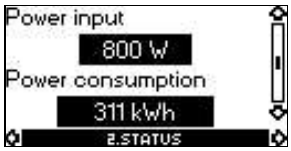
If no sensor is connected to the pump, "-" will appear in the display.

4.3.4 Speed

Tolerance: ± 5 %

The actual pump speed will appear in this display.

4.3.5 Power input and power consumption



Tolerance: ± 10 %

This display shows the actual pump input power from the power supply. The power is displayed in W or kW.

The pump power consumption can also be read from this display. The value of power consumption is an accumulated value calculated from the pump's birth and it cannot be reset.

4.3.6 Operating hours

Tolerance: ± 2 %

The value of operating hours is an accumulated value and cannot be reset.

4.3.7 Lubrication status of motor bearings (only 20-30 hp)

This display shows how many times the motor bearings have been relubricated and when to replace the motor bearings.

When the motor bearings have been relubricated, confirm this action in the INSTALLATION menu. See section *4.4.14 Confirming relubrication/replacement of motor bearings (only three-phase pumps).* When relubrication is confirmed, the figure in the above display will be increased by one.

4.3.8 Time till relubrication of motor bearings

This display shows when to relubricate the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing relubrications. If the operating pattern changes, the calculated time till relubrication may change as well.

The displayable values are these:

- in 2 years
- in 1 year
- in 6 months
- in 3 months
- in 1 month
- in 1 week
- Now!

4.3.9 Time till replacement of motor bearings

When the motor bearings have been relubricated a prescribed number of times stored in the controller, the display in section *4.3.8 Time till relubrication of motor bearings* will be replaced by the display below.

This display shows when to replace the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing replacements.

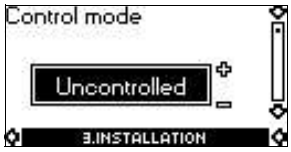
The displayable values are these:

- in 2 years
- in 1 year
- in 6 months
- in 3 months
- in 1 month
- in 1 week
- Now!

4.4 Menu INSTALLATION

4.4.1 Control mode

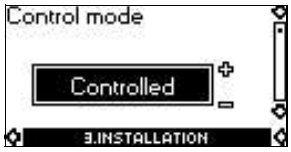
Without sensor (uncontrolled)



Select one of the following control modes (see fig. 14):

- Controlled
- Uncontrolled.

With pressure sensor (controlled)



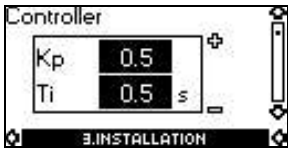
Select one of the following control modes (see fig. 14):

- Controlled
- Uncontrolled.

If the pump is connected to a bus, the control mode cannot be selected via the R100. See section *4.9 Bus signal*.

4.4.2 Controller

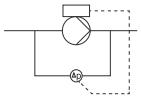
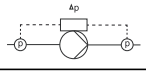
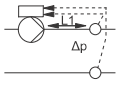
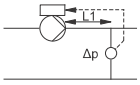
E-pumps have a factory default setting of gain (K_p) and integral time (T_i). However, if the factory setting is not the optimum setting, the gain and the integral time can be changed in the display below.



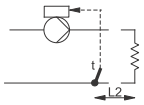
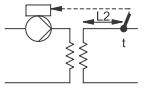
- The gain (K_p) can be set within the range from 0.1 to 20.
- The integral time (Ti) can be set within the range from 0.1 to 3600 s. If 3600 s is selected, the controller will function as a P controller.
- Furthermore, it is possible to set the controller to inverse control, meaning that if the setpoint is increased, the speed will be reduced. In the case of inverse control, the gain (Kp) must be set within the range from -0.1 to -20.

Guidelines for setting of PI controller

The tables below show the recommended controller settings:

Constant differential pressure	K_p	T_i
	0.5	0.5
		
	0.5	L1 < 5 m: 0.5 L1 > 5 m: 3 L1 > 10 m: 5
		

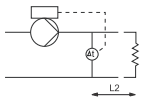
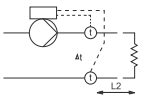
L1: distance in meters between pump and sensor.

Constant temperature	K_p		T_i
	Heating system[1)]	Cooling system[2)]	
	0.5	-0.5	10 + 5L2
	0.5	-0.5	30 + 5L2

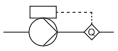
1) In heating systems, an increase in pump performance results in a rise in temperature at the sensor.

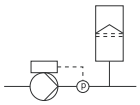
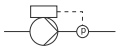
2) In cooling systems, an increase in pump performance results in a drop in temperature at the sensor.

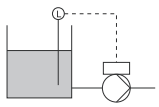
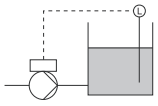
L2: distance in meters between heat exchanger and sensor.

Constant differential temperature	K_p	T_i
	-0.5	10 + 5L2
		

L2: Distance [m] between heat exchanger and sensor.

Constant flow rate	K_p	T_i
	0.5	0.5

Constant pressure	K_p	T_i
	0.5	0.5
	0.5	0.5

Constant level	K_p	T_i
	-20	0
	20	0

General rules of thumb

If the controller is too slow-reacting, increase the gain.

If the controller is hunting or unstable, dampen the system by reducing the gain or increasing the integral time.

How to set the PI controller

For most applications, the factory setting of the controller constants K_p and T_i will ensure optimum pump operation. However, in some applications an adjustment of the controller may be needed.

Proceed as follows:

1. Increase the gain (K_p) until the motor becomes unstable. Instability can be seen by observing if the measured value starts to fluctuate. Furthermore, instability is audible as the motor starts hunting up and down.
   Some systems, such as temperature controls, are slow-reacting, meaning that it may be several minutes before the motor becomes unstable.
2. Set the gain (K_p) to half of the value which made the motor unstable. This is the correct setting of the gain.
3. Reduce the integral time (T_i) until the motor becomes unstable.
4. Set the integral time (T_i) to twice the value which made the motor unstable. This is the correct setting of the integral time.

General rules of thumb:

- If the controller is too slow-reacting, increase K_p.
- If the controller is hunting or unstable, dampen the system by reducing K_p or increasing T_i.

4.4.3 External setpoint

The input for external setpoint signal can be set to different signal types.

Select one of the following types:

- 0-10 V
- 0-20 mA
- 4-20 mA
- Not active.

If Not active is selected, the setpoint set by means of the R100 or on the control panel will apply.

If one of the signal types is selected, the actual setpoint is influenced by the signal connected to the external setpoint input. See section *4.8 External setpoint signal*

4.4.4 Signal relay

Pumps of 20-30 hp have two signal relays. Signal relay 1 is factory set to Alarm and signal relay 2 to Warning.

In one of the displays below, select in which one of three or six operating situations the signal relay should be activated.

20-30 hp

- Ready
- Alarm
- Operation
- Pump running
- Warning
- Relubricate.

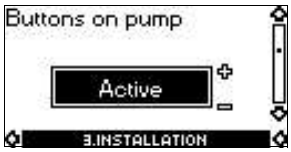
20-30 hp

- Ready
- Alarm
- Operation
- Pump running
- Warning
- Relubricate.

Fault and Alarm cover faults resulting in Alarm. Warning covers faults resulting in Warning. Relubricate covers only that one individual event. For distinction between alarm and warning, see section *4.2.3 Fault indications*.

For further information, see section *4.11 Indicator lights and signal relay*.

4.4.5 Buttons on pump



The operating buttons ⊙ and ⊙ on the control panel can be set to these values:

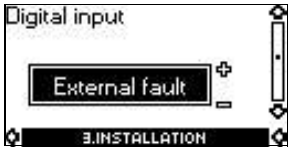
- Active
- Not active.

When set to Not active (locked), the buttons do not function. Set the buttons to Not active if the pump should be controlled via an external control system.

4.4.6 Pump number

A number between 1 and 64 can be allocated to the pump. In the case of bus communication, a number must be allocated to each pump.

4.4.7 Digital inputs



The digital inputs of the pump can be set to different functions.

Select one of the following functions:

- Min. (min. curve)
- Max. (max. curve)
- External fault
- Flow switch
- Dry running (from external sensor) (only three-phase pumps).

The selected function is activated by closing the contact between terminals 1 and 9, 1 and 10 or 1 and 11.

See also section *4.7 Digital input*.

***Min.*:**

When the input is activated, the pump will operate according to the min. curve.

***Max.*:**

When the input is activated, the pump will operate according to the max. curve.

***External fault*:**

When the input is activated, a timer will be started. If the input is activated for more than 5 seconds, the pump will be stopped and a fault will be indicated. If the input is deactivated for more than 5 seconds, the fault condition will cease and the pump can only be restarted manually by resetting the fault indication.

***Flow switch*:**

When this function is selected, the pump will be stopped when a connected flow switch detects low flow.

It is only possible to use this function if the pump is connected to a pressure sensor.

If the input is activated for more than 5 seconds, the stop function incorporated in the pump will take over. See section *4.4.8 Stop function*.

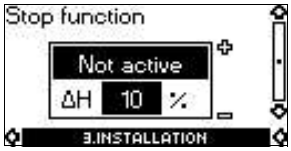
Dry running

When this function is selected, lack of inlet pressure or water shortage can be detected. This requires the use of an accessory, such as these:

- a Grundfos Liqtec® dry-running sensor
- a pressure switch installed on the suction side of a pump
- a float switch installed on the suction side of a pump.

When lack of inlet pressure or water shortage (Dry running) is detected, the pump will be stopped. The pump cannot restart as long as the input is activated.

4.4.8 Stop function



The stop function can be set to these values:

- Active
- Not active.

When the stop function is active, the pump will be stopped at very low flows. The controller will stop the pump to protect the pump as follows:

- avoid unnecessary heating of the pumped liquid
- reduce wear of the shaft seals
- reduce noise from operation.

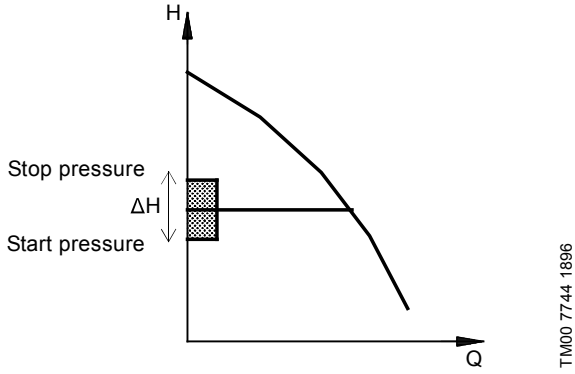


Fig. 15 Difference between start and stop pressures (ΔH)

ΔH is factory-set to **10 % of actual setpoint**.

ΔH can be set within the range from 5 % to 30 % of actual setpoint.

Low flow can be detected in two different ways:

1. A built-in "low-flow detection function" which functions if the digital input is not set up for flow switch.
2. A flow switch connected to the digital input.

1. Low-flow detection function

The pump will check the flow regularly by reducing the speed for a short time. If there is no or only a small change in pressure, this means that there is low flow. The speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached and the pump will stop. When the pressure has fallen to the start pressure (actual setpoint - 0.5 x ΔH), the pump will restart.

When restarting, the pumps will react differently according to pump type:

Three-phase pumps

1. If the flow is higher than the low-flow limit, the pump will return to continuous operation at constant pressure.
2. If the flow is still lower than the low-flow limit, the pump will continue in start/stop operation. It will continue in start/stop operation until the flow is higher than the low-flow limit; when the flow is higher than the low-flow limit, the pump will return to continuous operation.

2. Flow switch

When the digital input is activated for more than 5 seconds because there is low flow, the speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached, and the pump will stop. When the pressure has fallen to start pressure, the pump will start again. If there is still no flow, the pump will quickly reach stop pressure and stop. If there is flow, the pump will continue operating according to the setpoint.

Operating conditions for the stop function

It is only possible to use the stop function if the system incorporates a pressure sensor, a non-return valve and a diaphragm tank.

The non-return valve must always be installed before the pressure sensor. See fig. 16 and 17.

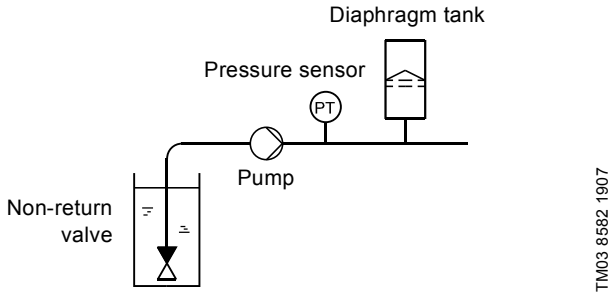


Fig. 16 Position of the non-return valve and pressure sensor in system with suction lift operation

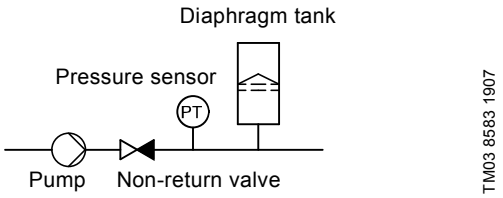


Fig. 17 Position of the non-return valve and pressure sensor in system with positive inlet pressure

Diaphragm tank

The stop function requires a diaphragm tank of a certain minimum size. The tank must be installed immediately after the pump and the precharge pressure must be 0.7 x actual setpoint.

Recommended diaphragm tank size:

Rated flow of pump [gpm (m^3h)]	CRE pump	Typical diaphragm tank size [gal (liter)]
0-26 (0 - 5.9)	1s, 1, 3	2 (7.6)
27-105 (6.1 - 23.8)	5, 10, 15	4.4 (16.7)
106-176 (24.2 - 40)	20, 32	14 (53.0)
177-308 (40.2 - 70.0)	45	34 (128.7)
309-440 (70.2 - 99.9)	64, 90	62 (234.7)
441-750 (100-170)	120, 150	86 (325.5)

If a diaphragm tank of the above size is installed in the system, the factory setting of ΔH is the correct setting.

If the tank installed is too small, the pump will start and stop too often. This can be remedied by increasing ΔH.

4.4.9 Flow limit for the stop function

– Flow limit for the stop function only works if the system is not set up for flow switch.

In order to set at which flow rate the system is to go from continuous operation at constant pressure to start/stop operation, select among these four values of which three are preconfigured flow limits:

- Low
- Normal
- High
- Custom.

The default setting of the pump is Normal, representing approx. 10 % of the rated flow rate of the pump.

If a lower flow limit than normal is desired or the tank size is smaller than recommended, select Low.

If a higher flow than normal is wanted or a large tank is used, set the limit to High.

The value Custom can be seen in R100 but it can only be set by means of the PC Tool E-products. Custom is for customized set-up and optimizing to the process.

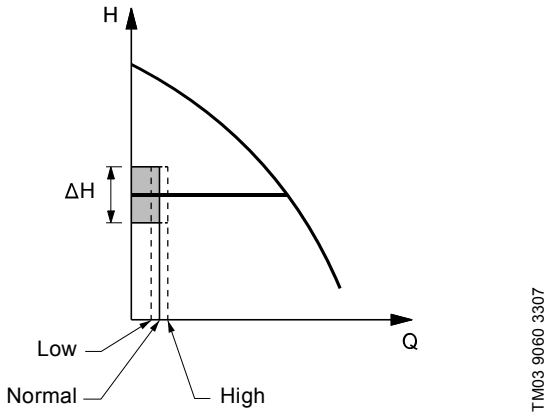
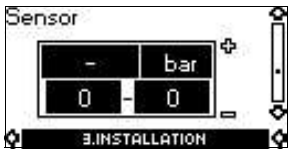


Fig. 18 Three preconfigured flow limits, *Low*, *Normal* and *High*

4.4.10 Sensor

Without sensor (uncontrolled)



With pressure sensor (controlled)

The setting of the sensor is only relevant in the case of controlled operation.

Select among the following values:

- Sensor output signal
  0-10 V
  0-20 mA
  4-20 mA.
- Unit of measurement of sensor:
  bar, mbar, m, kPa, psi, ft, m^3/h, m^3/s, l/s, gpm, °C, °F, %,
- Sensor measuring range.

4.4.11 Duty/standby

The duty/standby function applies to two pumps connected in parallel and controlled via GENIbus.

The duty/standby function can be set to these values:

- Active
- Not active.

When the function is set to Active, the following applies:

- Only one pump is running at a time.
- The stopped pump (standby) will automatically be cut in if the running pump (duty) has a fault. A fault will be indicated.
- Changeover between the duty pump and the standby pump will take place every 24 hours.

Activate the duty/standby function as follows:

1. Install and prime the two pumps according to the installation and operating instructions supplied with the pumps.
2. Check that the power supply is connected to the first pump according to the installation and operating instructions.
3. Use Grundfos R100 to set the duty/standby to Not active in the installation menu.
4. Use Grundfos R100 to set the Operating mode to Stop in the operation menu.
5. Use Grundfos R100 to set the other displays as required for the pump application (such as setpoint).
6. Disconnect the power supply to both pumps.
7. Installation of the AYB cable (91125604):
   a. Remove the plug from each MLE terminal box with a flat head screw driver. See fig. 19.
   b. Screw a new cable gland into each MLE terminal box with a crescent wrench. See fig. 19.
   c. Loosen the new cable gland caps and push the cable ends through the cable glands and into MLE motors.
   d. Remove the AYB connector plug from the first MLE motor. See fig. 20.
   e. Connect the black wire to the A terminal of the AYB connector plug.
   f. Connect the orange wire to the Y terminal of the AYB connector plug.
   g. Connect the red wire to the B terminal of the AYB connector plug.
   h. Reconnect the AYB connector plug to the first MLE motor.
   i. Tighten the cable gland cap to secure the cable. See fig. 19.
   j. Repeat steps d to i for the second MLE motor.
8. Connect the power supply to the two pumps according to the installation and operation instructions.
9. Use Grundfos R100 to check that the Operating mode is set to Normal in the operation menu of the second pump.
10. Use Grundfos R100 to set the other displays as required for the pump application (such as Setpoint).
11. Use Grundfos R100 to set the duty/standby to Active in the installation menu of the second pump. Please note the second pump will search for the first pump and automatically set the duty/standby to Active in the installation menu.
12. The second pump will operate for the first 24 hours. The two pumps will then alternate operation every 24 hours.

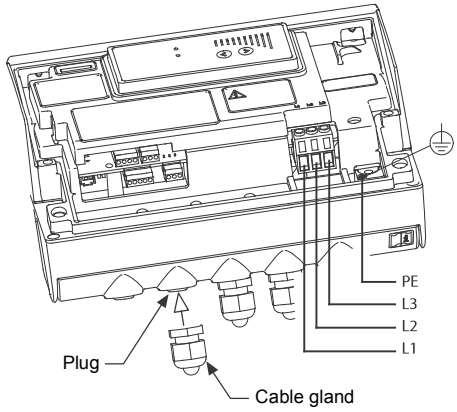
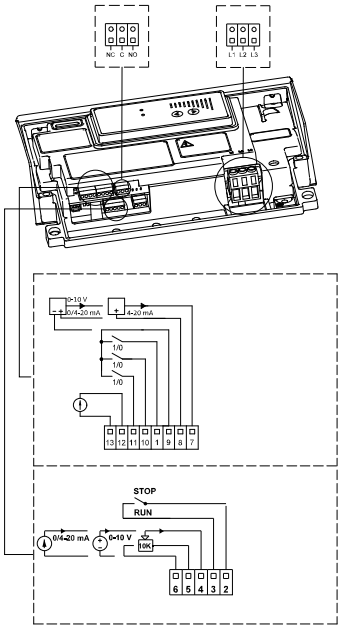


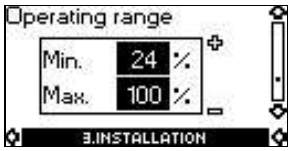
Fig. 19 Removing the plug and connecting cable gland to the terminal box



TM05 2985 0812

Fig. 20 AYB connector plug

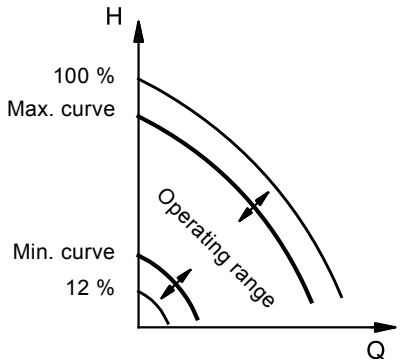
4.4.12 Operating range



How to set the operating range:

- Set the min. curve within the range from max. curve to 12 % of maximum performance. The pump is factory-set to 24 % of maximum performance.
- Set the max. curve within the range from maximum performance (100 %) to min. curve.

The area between the min. and max. curves is the operating range.



TM00 7747 1896

Fig. 21 Setting of the min. and max. curves in % of maximum performance

4.4.13 Motor bearing monitoring (only three-phase pumps)

The motor bearing monitoring function can be set to these values:

- Active
- Not active.

When the function is set to Active, a counter in the controller will start counting the mileage of the bearings. See section *4.3.7 Lubrication status of motor bearings (only 20-30 hp)*.

– The counter will continue counting even if the function is switched to Not active, but a warning will not be given when it is time for relubrication.
– When the function is switched to Active again, the accumulated mileage will again be used to calculate the relubrication time.

4.4.14 Confirming relubrication/replacement of motor bearings (only three-phase pumps)

This function can be set to these values:

- Relubricated (only 20-30 hp)
- Replaced
- Nothing done.

When the bearing monitoring function is Active, the controller will give a warning indication when the motor bearings are due to be relubricated or replaced. See section *4.2.3 Fault indications*.

When the motor bearings have been relubricated or replaced, confirm this action in the above display by pressing OK.

Relubricated cannot be selected for a period of time after confirming relubrication.

4.4.15 Standstill heating (only three-phase pumps)

The standstill heating function can be set to these values:

- Active
- Not active.

When the function is set to Active, an AC voltage will be applied to the motor windings. The applied voltage will ensure that sufficient heat is generated to avoid condensation in the motor.

4.5 Typical display settings for constant-pressure E-pumps

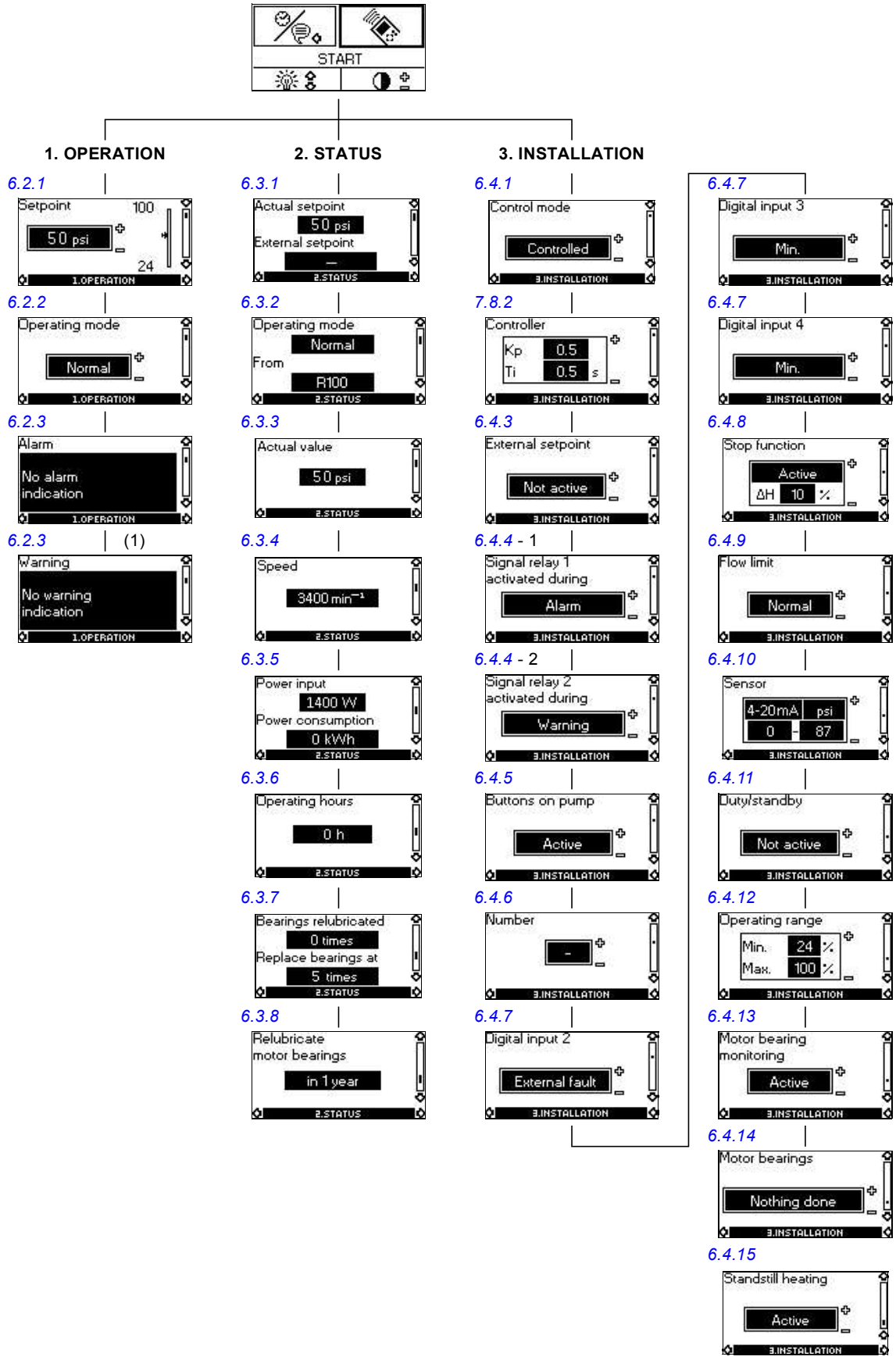


Fig. 22 Menu overview

4.6 Typical display settings for analog-input E-pumps

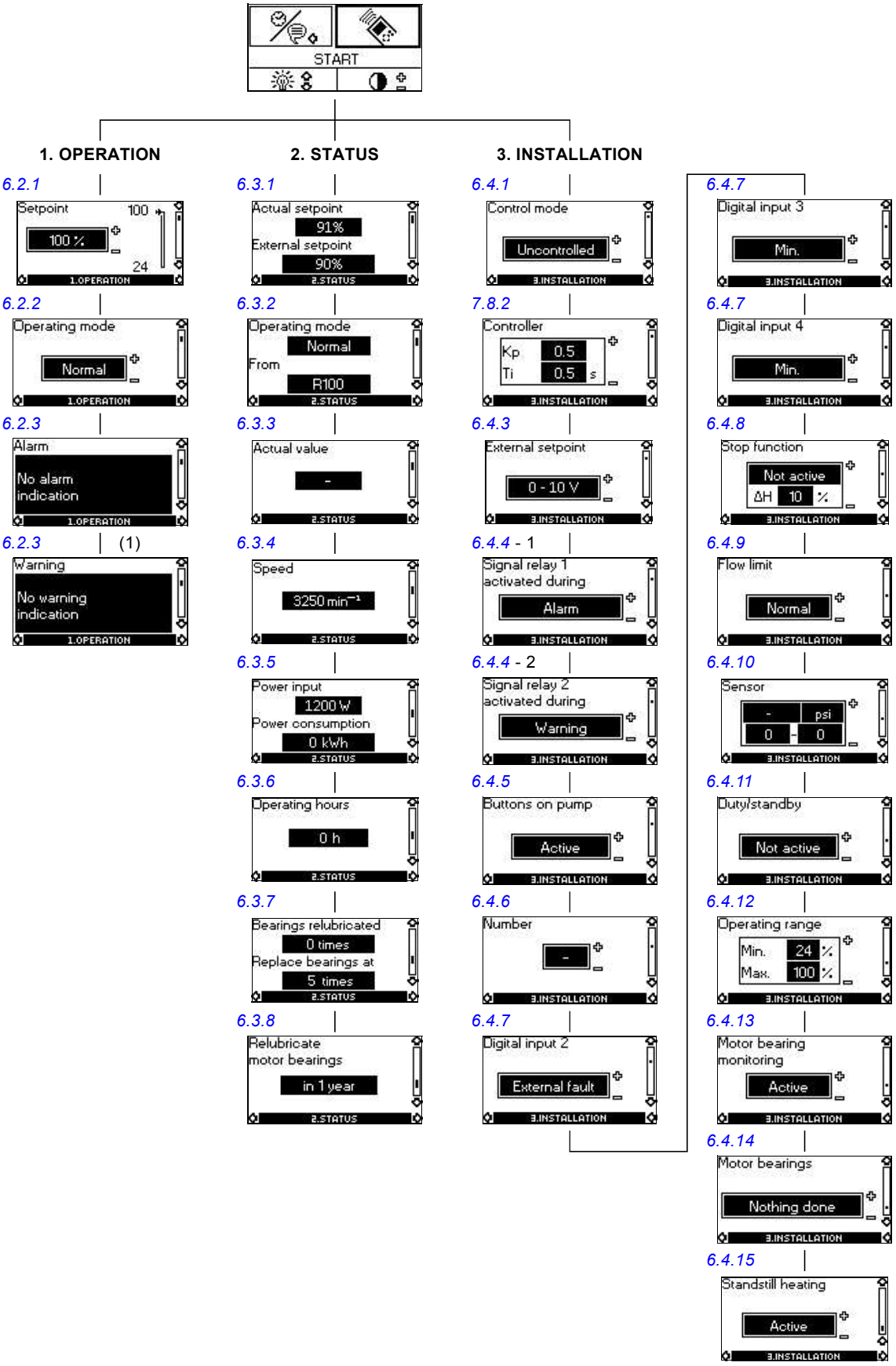


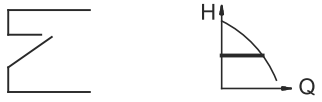
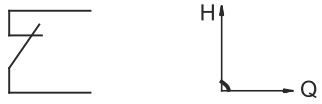
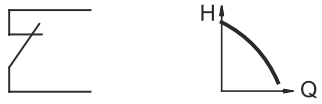
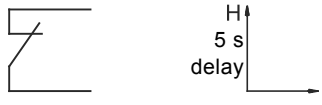
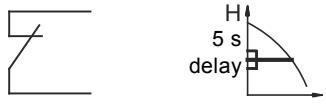
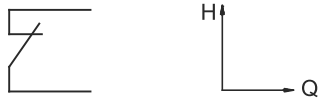
Fig. 23 Menu overview

4.7 Digital input

By means of the R100, one of the following functions can be selected for the digital input:

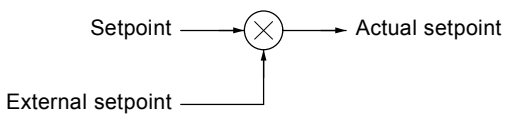
- Normal duty
- Min. curve
- Max. curve
- External fault
- Flow switch
- Dry running.

Functional diagram: Input for digital function

Digital function (terminals 1 and 9) (terminals 9 and 10) (terminals 9 and 11)	
	**Normal duty**
	**Min. curve**
	**Max. curve**
	**External fault**
	**Flow switch**
	**Dry running**

4.8 External setpoint signal

The setpoint can be remote-set by connecting an analogue signal transmitter to the input for the setpoint signal (terminal 4).



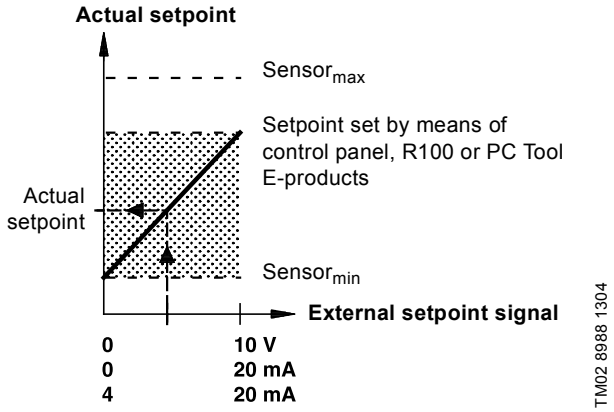
TM03 8601 2007

Fig. 24 Actual setpoint as a product (multiplied value) of setpoint and external setpoint

Select the actual external signal, 0-10 V, 0-20 mA, 4-20 mA, via the R100. See section *4.4.3 External setpoint*.

If control mode **uncontrolled** is selected by means of the R100, the pump can be controlled by any controller.

In control mode **controlled**, the setpoint can be set externally within the range from the lower value of the sensor measuring range to the setpoint set on the pump or by means of the R100.



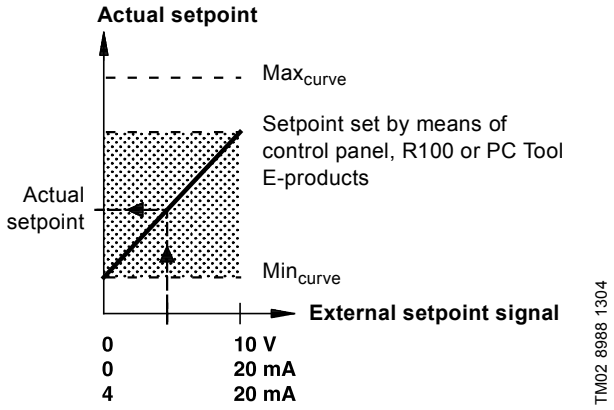
TM02 8988 1304

Fig. 25 Relation between the actual setpoint and the external setpoint signal in control mode controlled

Example: At a sensor$_{min}$ value of 0 psi, a setpoint set of 50 psi and an external setpoint of 80 % (an 8 V analog signal to Terminal 4 if using an analog signal of 0-10 V), the actual setpoint will be as follows:

$$\text{Actual setpoint} = (\text{setpoint} - \text{sensor}_{min}) \times \%_{\text{external setpoint}} + \text{sensor}_{min}$$
$$= (50 - 0) \times 80\ \% + 0$$
$$= 40 \text{ psi}$$

In control mode **uncontrolled**, the setpoint can be set externally within the range from the min. curve to the setpoint set on the pump or by means of the R100. Typically the setpoint is set to 100 % when the control mode is uncontrolled (see section *4.6 Typical display settings for analog-input E-pumps*).



TM02 8988 1304

Fig. 26 Relation between the actual setpoint and the external setpoint signal in control mode uncontrolled

4.9 Bus signal

The pump supports serial communication via an RS-485 input. The communication is carried out according to Grundfos bus protocol, GENIbus protocol, and enables connection to a building management system or another external control system.

Operating parameters, such as setpoint, operating mode, etc. can be remote-set via the bus signal. At the same time, the pump can provide status information about important parameters, such as actual value of control parameter, input power, fault indications, etc.

Contact Grundfos for further details.

If a bus signal is used, the number of settings available via the R100 will be reduced.

4.10 Other bus standards

Grundfos offers various bus solutions with communication according to other standards.

Contact Grundfos for further details.

4.11 Indicator lights and signal relay

The operating condition of the pump is indicated by the green and red indicator lights fitted on the pump control panel and inside the terminal box. See fig. 27.

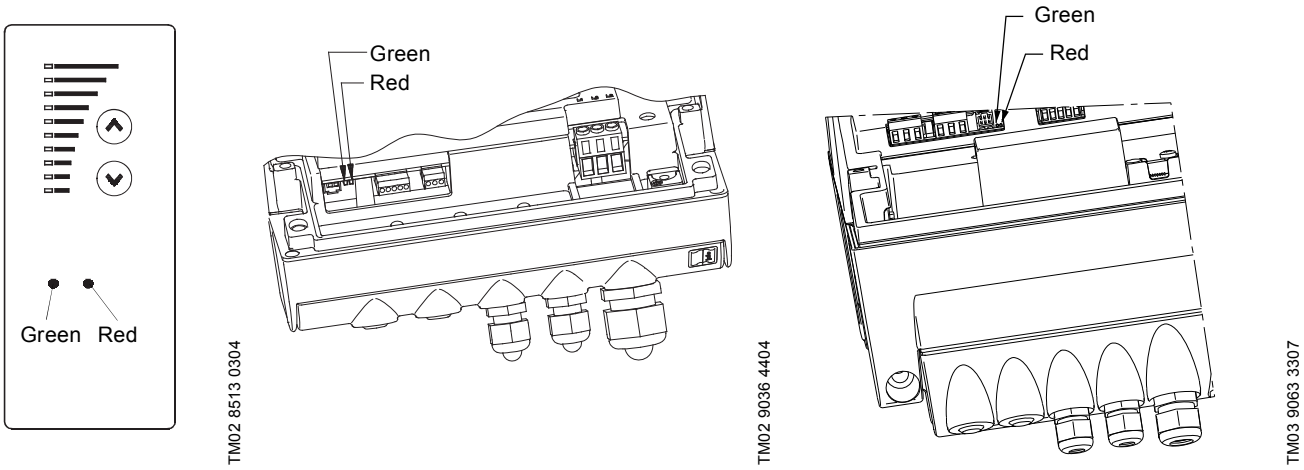
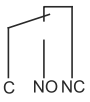
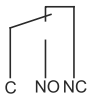
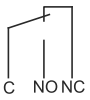
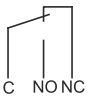
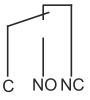
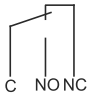
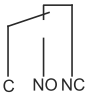


Fig. 27 Position of indicator lights

Besides, the pump incorporates an output for a potential-free signal via an internal relay.

For signal relay output values, see section *4.4.4 Signal relay*.

The functions of the two indicator lights and the signal relay are as shown in the following table:

Indicator lights		Signal relay activated during:				Description
Fault (red)	Operation (green)	Fault/Alarm, Warning and Relubricate	Operating	Ready	Pump running	
Off	Off					The power supply has been switched off.
Off	Permanently on					The pump is operating.
Off	Permanently on					The pump is stopped by the stop function.
Off	Flashing					The pump has been set to stop.
Permanently on	Off					The pump has stopped because of a Fault/Alarm or is running with a Warning or Relubricate indication. If the pump was stopped, restarting will be attempted (it may be necessary to restart the pump by resetting the Fault indication). If the cause is "external fault", the pump must be restarted manually by resetting the Fault indication.
Permanently on	Permanently on					The pump is operating, but it has or has had a Fault/Alarm allowing the pump to continue operation or it is operating with a Warning or Relubricate indication. If the cause is "sensor signal outside signal range", the pump will continue operating according to the 70 % curve and the fault indication cannot be reset until the signal is inside the signal range. If the cause is "setpoint signal outside signal range", the pump will continue operating according to the min. curve and the fault indication cannot be reset until the signal is inside the signal range.
Permanently on	Flashing					The pump has been set to stop, but it has been stopped because of a Fault.

Resetting of fault indication

A fault indication can be reset in one of the following ways:

- Briefly press the button ⊙ or ⊙ on the pump. This will not change the setting of the pump.
  A fault indication cannot be reset by means of ⊙ or ⊙ if the buttons have been locked.
- Switch off the power supply until the indicator lights are off.
- Switch the external start/stop input off and then on again.
- Use the R100. See section, *4.2.3 Fault indications*.

When the R100 communicates with the pump, the red indicator light will flash rapidly.

5. Setting the product

5.1 Factory setting

5.1.1 Pumps without factory-fitted sensor

The pumps have been factory-set to control mode uncontrolled. The setpoint value corresponds to 100 % of the maximum pump performance (see data sheet for the pump).

5.1.2 Pumps with pressure sensor

The pumps have been factory-set to control mode controlled. The setpoint value corresponds to 50 % of the sensor measuring range (see sensor nameplate).

5.2 Setting by means of control panel

The pump control panel, see fig. 28, incorporates the following buttons and indicator lights:

- Buttons, ⌃ and ⌄, for setpoint setting.
- Light fields, yellow, for indication of setpoint.
- Indicator lights, green (operation) and red (fault).

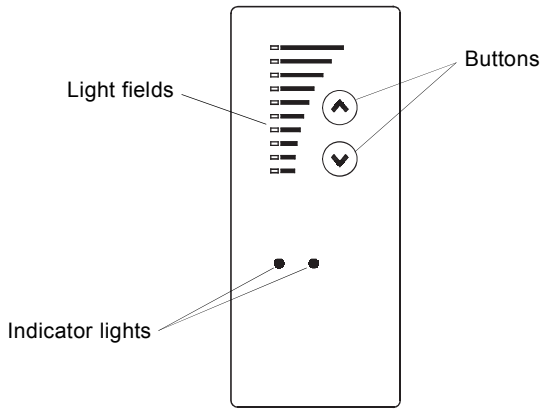


Fig. 28 Control panel, three-phase pumps, 20-30 hp

5.3 Setting of operating mode

Settings available:

- Normal
- Stop
- Min.
- Max.

Start/stop of pump

Start the pump by continuously pressing ⌃ until the desired setpoint is indicated. This is operating mode Normal.

Stop the pump by continuously pressing ⌄ until none of the light fields are activated and the green indicator light flashes.

Setting to Min.

Press ⌄ continuously to change to the min. curve of the pump (bottom light field flashes). When the bottom light field is on, press ⌄ for 3 seconds until the light field starts flashing.

To return to uncontrolled or controlled operation, press ⌃ continuously until the desired setpoint is indicated.

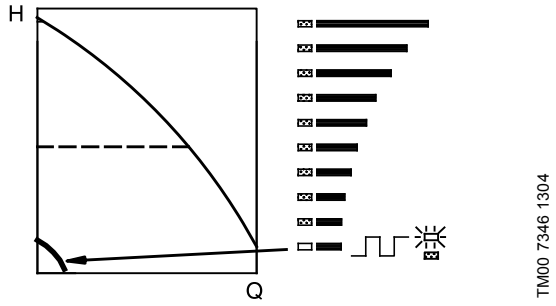


Fig. 29 Min. curve duty

Setting to Max.

Press ⌃ continuously to change to the max. curve of the pump (top light field flashes). When the top light field is on, press ⌃ for 3 seconds until the light field starts flashing.

To return to uncontrolled or controlled operation, press ⌄ continuously until the desired setpoint is indicated.

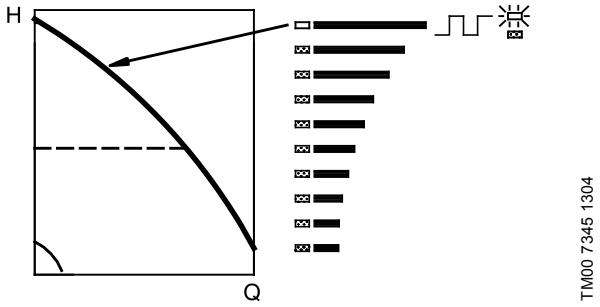


Fig. 30 Max. curve duty

5.4 Setpoint setting

Set the desired setpoint by pressing the button ⊙ or ⊙.

The light fields on the control panel will indicate the setpoint set. See examples in the following sections: *5.4.1 Pump in control mode controlled (pressure control)* and *5.4.2 Pump in control mode uncontrolled*.

5.4.1 Pump in control mode controlled (pressure control)

Example

Figure 31 shows that the light fields 5 and 6 are activated, indicating a desired setpoint of 3 bar. The setting range is equal to the sensor measuring range (see sensor nameplate).

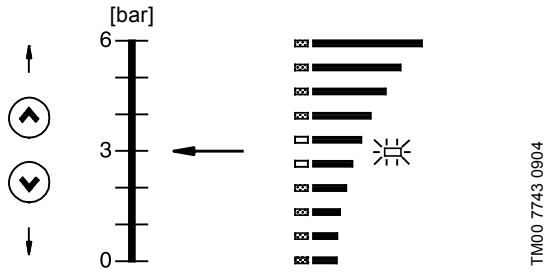


Fig. 31 Setpoint set to 3 bar, pressure control

5.4.2 Pump in control mode uncontrolled

Example

In control mode uncontrolled, the pump performance is set within the range from min. to max. curve. See fig. 32.

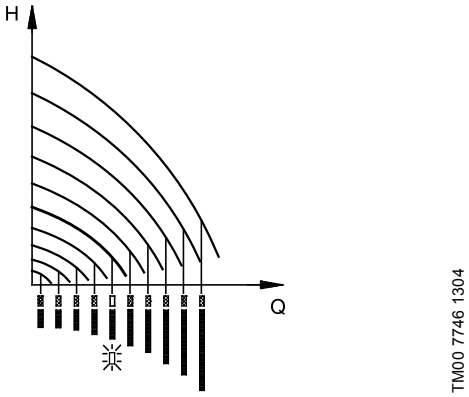


Fig. 32 Pump performance setting, control mode uncontrolled

5.5 Setting by means of R100

The pump is designed for wireless communication with Grundfos remote control R100.

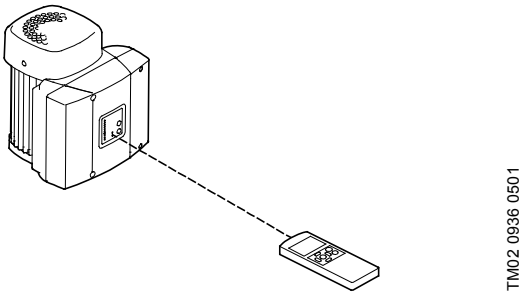


Fig. 33 R100 communicating with the pump via infra-red light

During communication, the R100 must be pointed at the control panel. When the R100 communicates with the pump, the red indicator light will flash rapidly. Keep pointing the R100 at the control panel until the red LED diode stops flashing.

The R100 offers setting and status displays for the pump.

The displays are divided into four parallel menus (see fig. 22):

0. GENERAL (see operating instructions for the R100)
1. OPERATION
2. STATUS
3. INSTALLATION

The figure above each individual display in fig. 22 refers to the section in which the display is described.

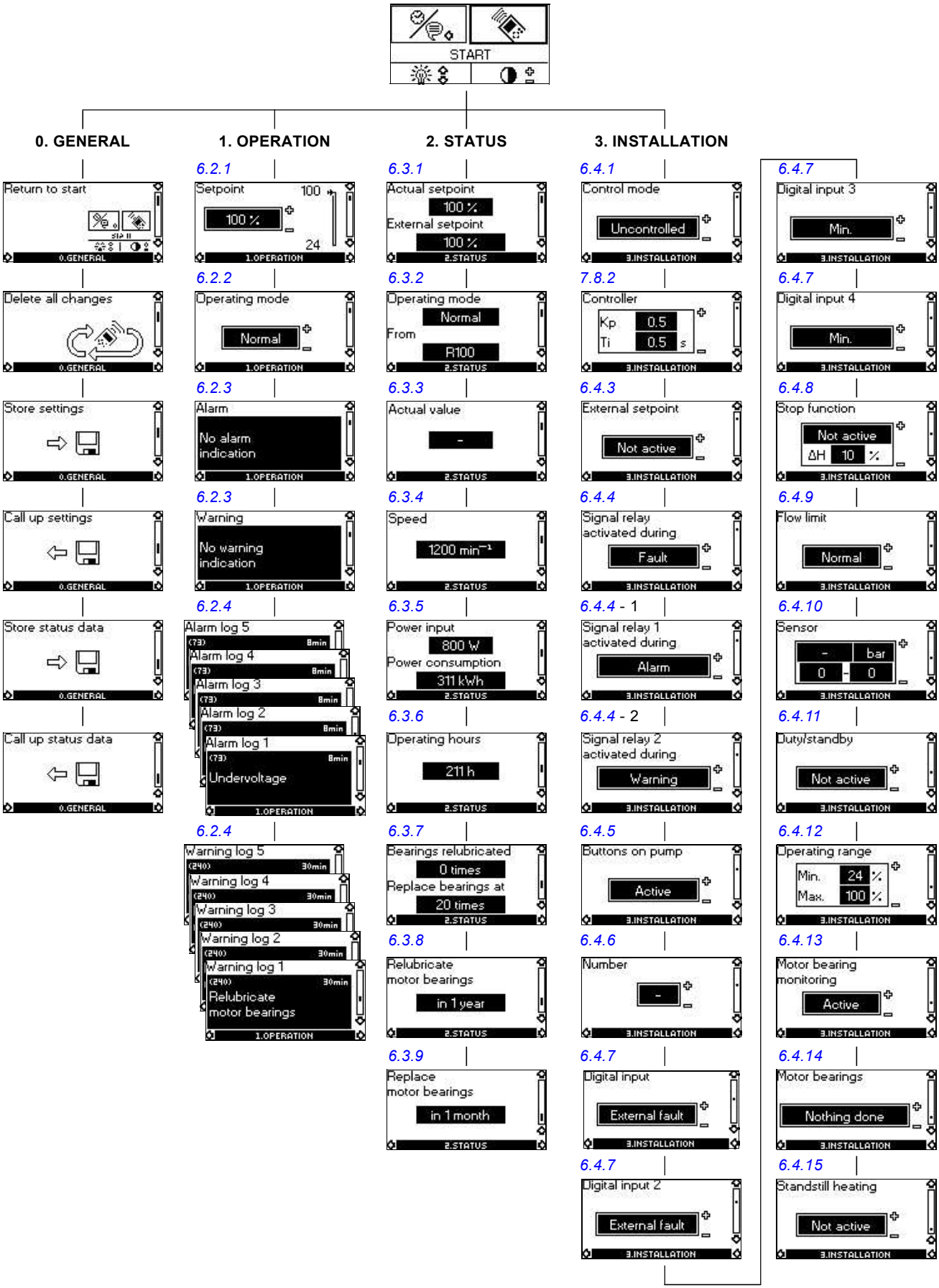


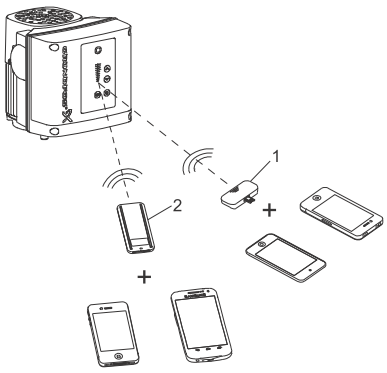
Fig. 34 Menu overview

5.6 Grundfos GO

The pump is designed for wireless radio or infrared communication with Grundfos GO.

Grundfos GO enables setting of functions and gives access to status overviews, technical product information and actual operating parameters.

Grundfos GO offers the following mobile interfaces (MI).



TM06 6256 0916

Fig. 35 Grundfos GO communicating with the pump via radio or infrared connection (IR)

Pos.	Description
1	Grundfos MI 204: Add-on module enabling radio or infrared communication. You can use MI 204 in conjunction with an Apple iPhone or iPod with Lightning connector, such as fifth generation or later iPhone or iPod. MI 204 is also available together with an Apple iPod touch and a cover.
2	Grundfos MI 301: Separate module enabling radio or infrared communication. You can use the module in conjunction with an Android or iOS-based smart device with Bluetooth connection.

5.6.1 Communication

When Grundfos GO Remote communicates with the pump, the indicator light in the middle of the Grundfos Eye will flash green.

Communication must be established using one of these communication types:

- radio communication
- infrared communication.

Radio communication

Radio communication can take place at distances up to 30 meters. It is necessary to enable communication by pressing or OK on the pump control panel.

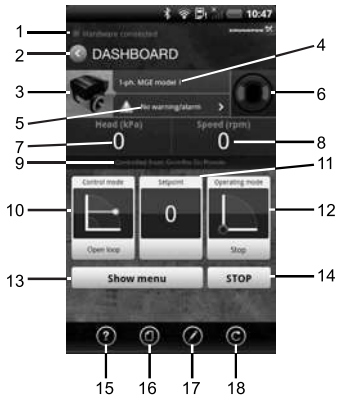
Infrared communication

When communicating via infrared light, Grundfos GO Remote must be pointed at the pump control panel.

5.6.2 Navigation

Navigation can be done from the dashboard. See fig. 36.

Dashboard



TM05 5609 3912

Fig. 36 Example of dashboard

Pos.	Description	Action
1	Connection indicator	This text appears when Grundfos GO Remote app has connected to an MI 201, MI 202 or MI 301. If the hardware is not connected, it will not be possible to communicate with a Grundfos product.
2	Back button	Returns to the previous display.
3	Product information	Provides technical information about the product.
4	Product name	Name of the product communicating with Grundfos GO Remote.
5	Alarms and warnings	Shows alarms and warnings.
6	Grundfos Eye	Shows the operating condition of the product.
7	Primary status value	Shows the primary status value.
8	Secondary status value	Shows the secondary status value.
9	Control source	Shows by which interface the product is controlled.
10	Control mode	Shows the control mode of the product.
11	Actual setpoint value	Shows the actual setpoint value.
12	Operating mode	Shows the operating mode.
13	Show menu	Gives access to other menus.
14	Stop	Stops the product.
Tool bar		
15	Help	The help function describes the menus making it easy for the user to change settings, etc.
16	Documentation	Gives access to installation and operating instructions and quick guides.
17	Report	Enables the creation of user-defined reports.
18	Update	Enables update of Grundfos GO Remote app.

5.7 Setting by means of PC Tool E-products

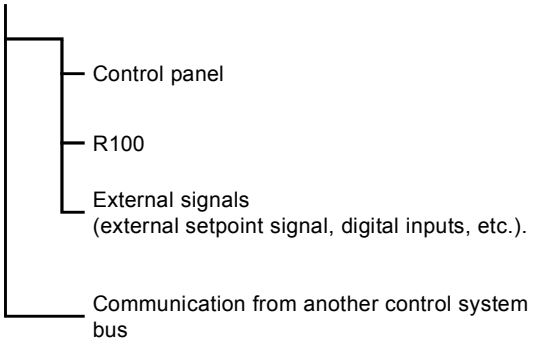
Special setup requirements differing from the settings available via the R100 require the use of Grundfos PC Tool E-products. This again requires the assistance of a Grundfos service technician or engineer. Contact your local Grundfos company for more information.

5.8 Priority of settings

The priority of settings depends on two factors:

1. control source
2. settings.

1. Control source



5.8.1 2. Settings

- Operating mode Stop
- Operating mode Max. (Max. curve)
- Operating mode Min. (Min. curve)
- Setpoint setting.

An E-pump can be controlled by different control sources at the same time, and each of these sources can be set differently. Consequently, it is necessary to set an order of priority of the control sources and the settings.

If two or more settings are activated at the same time, the pump will operate according to the function with the highest priority.

5.8.2 Priority of settings without bus communication

Priority	Control panel or R100	External signals
1	Stop	
2	Max.	
3		Stop
4		Max.
5	Min.	Min.
6	Setpoint setting	Setpoint setting

Example: If the E-pump has been set to operating mode Max. (Max. frequency) via an external signal, such as digital input, the control panel or R100 can only set the E-pump to operating mode Stop.

5.8.3 Priority of settings with bus communication

Priority	Control panel or R100	External signals	Bus communication
1	Stop		
2	Max.		
3		Stop	Stop
4			Max.
5			Min.
6			Setpoint setting

Example: If the E-pump is operating according to a setpoint set via bus communication, the control panel or R100 can set the E-pump to operating mode Stop or Max., and the external signal can only set the E-pump to operating mode Stop.

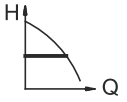
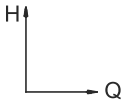
5.9 External forced-control signals

The pump has inputs for external signals for these forced-control functions:

- Start/stop of pump
- Digital function.

5.9.1 Start/stop input

Functional diagram: Start/stop input:

Start/stop (terminals 2 and 3)		
		**Normal duty**
		**Stop**

6. Taking the product out of operation

6.1 Emergency operation (only 20-30 hp)

DANGER

Electric Shock

Death or serious personal injury

– Never make any connections in the pump terminal box unless all electric supply circuits have been switched off for at least 5 minutes.

– Note for instance that the signal relay may be connected to an external supply which is still connected when the power supply is disconnected.

If the pump is stopped and you cannot start the pump immediately after normal remedies, the reason could be a faulty frequency converter. If this is the case it is possible to maintain emergency operation of the pump.

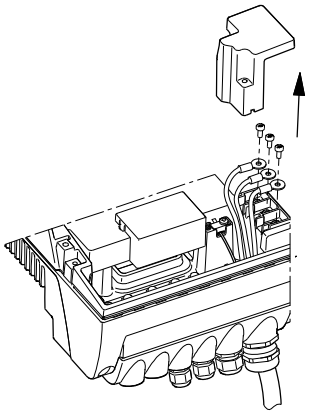
Before change over to emergency operation we recommend you to:

- check that the power supply is OK
- check that control signals are working (start/stop signals)
- check that all alarms are reset
- make a resistance test on the motor windings (disconnect the motor leads from the terminal box).

If the pump remains stopped it is possible that the frequency converter is faulty.

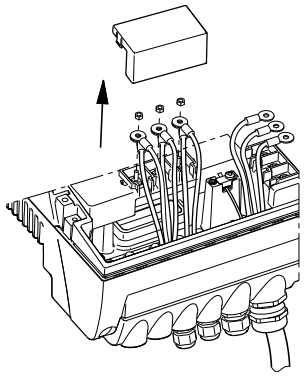
To establish emergency operation proceed as follows:

1. Disconnect the three power supply leads, L1, L2, L3, from the terminal box, but leave the protective ground lead(s) in position on the PE terminal(s).



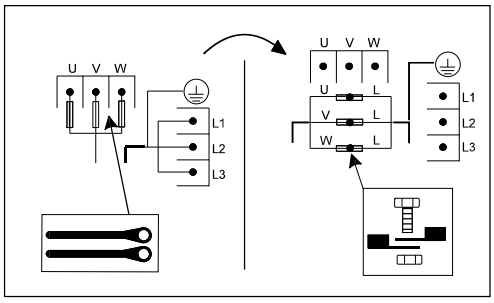
TM03 8607 2007

2. Disconnect the motor supply leads, U/W1, V/U1, W/V1, from the terminal box.



TM03 9120 3407

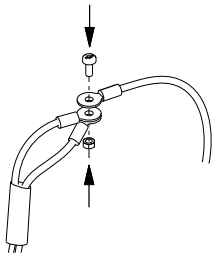
3. Connect the leads as shown in fig. 37.



TM04 0018 4807

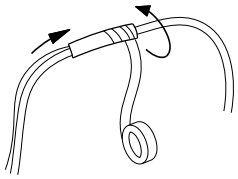
Fig. 37 How to switch an E-pump from normal operation to emergency operation

Use the screws from the power supply terminals and the nuts from the motor terminals.

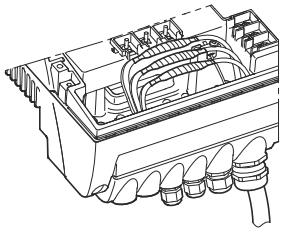


TM03 9121 3407

4. Insulate the three leads from each other by means of insulating tape or the like.



TM03 9122 3407



TM03 9123 3407

DANGER

Electric Shock

Death or serious personal injury

- Do not bypass the frequency converter by connecting the power supply leads to the U, V and W terminals.
- This may cause hazardous situations for personnel as the high voltage potential of the power supply may be transferred to touchable components in the terminal box.

Check the direction of rotation when starting up after switching to emergency operation.

5. A motor starter is required.

6.2 Insulation resistance

20-30 hp

- Do not measure the insulation resistance of an installation incorporating E-pumps using high voltage megging equipment, as this may damage the built-in electronics.
- The motor leads can be disconnected separately and the insulation resistance of the motor windings can be tested.

7. Servicing the product

7.1 Cleaning of the motor

Keep the motor cooling fins and fan blades clean to ensure sufficient cooling of the motor and electronics.

7.2 Relubrication of motor bearings

20-30 hp pumps

The motor bearings are of the open type and must be relubricated regularly. The motor bearings are prelubricated on delivery. The built-in bearing monitoring function will give a warning indication on the R100 when the motor bearings are due to be relubricated.

Before relubrication, remove the bottom plug in the motor flange and the plug in the bearing cover to ensure that old and excess grease can escape.

When relubricating the first time, use the double quantity of grease as the lubricating channel is still empty.

Frame size	Quantity of grease [ounces]	
	Drive end (DE)	Non-drive end (NDE)
MLE 160	.44	.44
MLE 180	.51	.51

The recommended grease type is a polycarbamide-based lubricating grease.

7.3 Replacement of motor bearings

20-30 hp motors have built-in bearing monitoring function which will give a warning indication on the R100 when the motor bearings are due to be replaced.

7.4 Replacement of varistor (only 20-30 hp)

The varistor protects the pump against voltage transients. If voltage transients occur, the varistor will be worn over time and need to be replaced. The more transients, the more quickly the varistor will be worn. When it is time to replace the varistor, R100 and PC Tool E-products will indicate this as a warning.

A Grundfos technician is required for replacement of the varistor. Contact your local Grundfos company for assistance.

7.5 Service parts and service kits

For further information on service parts and service kits, visit www.grundfos.com, select country, select Grundfos Product Center.

8. Technical data

8.1 Three-phase pumps, 20-30 hp

8.1.1 Supply voltage

3 x 460-480 V - 10 %/+ 10 %, 50/60 Hz - 3 %/+ 3 %, PE.

Cable: Max. 10 mm^2 / 8 AWG.

Use min. 158 °F (70 °C) copper conductors only.

Recommended fuse sizes

Motor size [hp]	Max. [A]
20	36
25	43
30	51

Standard as well as quick-blow or slow-blow fuses may be used.

8.1.2 Overload protection

The overload protection of the E-motor has the same characteristic as an ordinary motor protector. As an example, the E-motor can stand an overload of 110 % of I_{nom} for 1 min.

8.1.3 Leakage current

Ground leakage current > 10 mA.

The leakage currents are measured in accordance with EN 61800-5-1.

8.1.4 Inputs/output

Start/stop

External potential-free contact.

Voltage: 5 VDC.

Current: < 5 mA.

Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.

Digital

External potential-free contact.

Voltage: 5 VDC.

Current: < 5 mA.

Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.

Setpoint signals

- Potentiometer
  0-10 VDC, 10 kΩ (via internal voltage supply).
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 328 ft.
- Voltage signal
  0-10 VDC, R_i > 50 kΩ.
  Tolerance: + 0 %/- 3 % at maximum voltage signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.
- Current signal
  DC 0-20 mA/4-20 mA, R_i = 250 Ω.
  Tolerance: + 0 %/- 3 % at maximum current signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.

Sensor signals

- Voltage signal
  0-10 VDC, R_i > 50 kΩ (via internal voltage supply).
  Tolerance: + 0 %/- 3 % at maximum voltage signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.
- Current signal
  DC 0-20 mA/4-20 mA, R_i = 250 Ω.
  Tolerance: + 0 %/- 3 % at maximum current signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.

Internal power supplies

- 10 V power supply for external potentiometer:
  Max. load: 2.5 mA.
  Short-circuit protected.
- 24 V power supply for sensors:
  Max. load: 40 mA.
  Short-circuit protected.

Signal relay output

Potential-free changeover contact.
Maximum contact load: 250 VAC, 2 A, cos φ 0.3 - 1.
Minimum contact load: 5 VDC, 10 mA.
Screened cable: 0.5 - 2.5 mm^2 / 28-12 AWG.
Maximum cable length: 1640 ft.

Bus input

Grundfos bus protocol, GENIbus protocol, RS-485.
Screened 3-core cable: 0.2 - 1.5 mm^2 / 28-16 AWG.
Maximum cable length: 1640 ft.

8.2 Other technical data

EMC (electromagnetic compatibility to EN 61800-3)

Motor [hp]	Emission/immunity
20 25 30	**Emission:** The motors are category C3, corresponding to CISPR11, group 2, class A, and may be installed in **industrial areas** (second environment). If equipped with an external Grundfos EMC filter, the motors are category C2, corresponding to CISPR11, group 1, class A, and may be installed in **residential areas** (first environment). When the motors are installed in residential areas, supplementary measures may be required as the motors may cause radio interference. Motor sizes 25, and 30 hp comply with EN 61000-3-12 provided that the short-circuit power at the interface point between the user's electrical installation and the public power supply network is greater than or equal to the values stated below. It is the responsibility of the installer or user to ensure, by consultation with the power supply network operator, if necessary, that the motor is connected to a power supply with a short-circuit power greater than or equal to these values:

Motor size [hp]	Short-circuit power [kVA]
20	-
25	2700
30	3000

20 hp motors do not comply with EN 61000-3-12.

By installing an appropriate harmonic filter between the motor and the power supply, the harmonic current content will be reduced. In this way, the 20 hp motor will comply with EN 61000-3-12.

Immunity:

The motors fulfill the requirements for both the first and second environment.

Contact Grundfos for further information.

Enclosure class

- Three-phase pumps, 20-30 hp: IP55 (IEC 34-5)

Insulation class

F (IEC 85)

Ambient temperature

During operation:

- Minimum: -4 °F (-20 °C)
- Maximum: +104 °F (40 °C) without derating

During storage/transport:

- -13 °F (-25 °C) to +158 °F (70 °C) (20-30 hp)

Relative air humidity

Maximum 95 %.

Sound pressure level

Single-phase pump s:

< 70 dB(A).

Sound pressure level

Motor [hp]	Speed stated on the nameplate	Sound pressure level
20	3400-3600	70
25		74
30		78

9. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

1. Installation in the USA and Canada

In order to retain the UL/cUL approval, follow these additional installation procedures. The UL approval is according to UL508C.

1.1 Electrical connection

1.1.1 Conductors

Use minimum 140/167 °F (60/75 °C) copper conductors only.

1.1.2 Torques

Power terminals

Power terminal: 1.7 ft-lbs
Relay, M2.5: 0.4 ft-lbs
Input control, M2: 0.15 ft-lbs

1.1.3 Line reactors

Max. line reactor size must not exceed 2 mH.

1.1.4 Fuse size/circuit breaker

If a short circuit happens the pump can be used on a power supply delivering not more than 5000 RMS symmetrical amperes, 480 V maximum.

Fuses

When the pump is protected by fuses they must be rated for 600 V. Maximum sizes are stated in table below.

Up to 10 hp use Class K5 UL Listed fuses. For 10 to 30 hp use any class UL Listed fuse.

Circuit breaker

When the pump is protected by a circuit breaker, this must be rated for a maximum voltage of 480 V. The circuit breaker must be of the "Inverse time" type.

The interrupting rating (RMS symmetrical amperes) must not be less than the values stated in table below.

USA - hp

2-pole	4-pole	Fuse size	Circuit breaker type/model
1	1	25 A	25 A / Inverse time
1.5	1.5	25 A	25 A / Inverse time
2	2	25 A	25 A / Inverse time
3	3	25 A	25 A / Inverse time
5	5	40 A	40 A / Inverse time
7.5	-	40 A	40 A / Inverse time
10	7.5	50 A	50 A / Inverse time
15	15	80 A	80 A / Inverse time
20	20	110 A	110 A / Inverse time
25	25	125 A	125 A / Inverse time
30	-	150 A	150 A / Inverse time

1.1.5 Overload protection

Degree of overload protection provided internally by the drive, in percent of full-load current: 102 %.

1.2 General considerations

For installation in humid environment and fluctuating temperatures, it is recommended to keep the pump connected to the power supply continuously. This will prevent moisture and condensation build-up in the terminal box.

Start and stop must be done via the start/stop digital input (terminal 2-3).

1.3 Outdoor installation

According to UL 778/C22.2 No 108-14 pumps that are intended for outdoor use shall be marked enclosure type 3 and the product shall be tested with rated surface temperature down to -31 °F (-35 °C). The MLE enclosure is approved for type 3 or 4 and rated surface temperature down to 32 °F (0 °C), thus only for indoor use in UL 778/C22.2 No 108-14 pump applications. For ambient temperature during operation, see section *8.2 Other technical data*.

98566352 0818
ECM: 1240175

Hydro MPC

Installation and operating instructions

Primary Option: HydroMPC-E with CRE-45 pumps having integrated VFDs
Alternate Option: HydroMPC-EC with CR-45 pumps and panel mounted VFDs

CLASSIFIED
C UL US
WATER QUALITY
Drinking Water System Component
NSF / ANSI 61
NSF / ANSI 372

be
think
innovate

GRUNDFOS

Original installation and operating instructions

These installation and operating instructions apply to the Grundfos Hydro MPC pump system.

Sections 1-5 give the information necessary to be able to install the product in a safe way.

Sections 6-16 give important information about the product as well as information on service and fault finding.

CONTENTS

Read this document before you install the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Limited Warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

2. Symbols used in this document

2.1 Warnings against hazards involving risk of death or personal injury

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

2.2 Other important notes

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

3. Receiving the product

3.1 Transporting the product

Depending on the size, the pump system is delivered in an open wooden box or wooden or cardboard box designed for transport by forklift truck or a similar vehicle.

The forks of the forklift truck must be at least 6.6 ft (2 m) long.

The Hydro MPC pump systems with CR 125 or CR 155 pumps are secured by means of transport straps. Do not remove these transport straps until the pump system has been installed.

4. Installing the product

Before installing the product, check the following:

- The pump system corresponds to the order.
- All visible parts are intact.

4.1 Location

Install the pump system in a well-ventilated room to ensure sufficient cooling of the control cabinet and pumps.

Hydro MPC is only designed for indoor installation. Do not expose the product to direct sunlight.

Place the pump system with a 3.3 ft (1 m) clearance in front and on the two sides for inspection and removal.

4.2 Mechanical installation

4.2.1 Pipes

Arrows on the pump base show the direction of flow of water through the pump.

The pipes connected to the pump system must be of adequate size.

Connect the pipes to the manifolds of the pump system. Either end can be used. Apply sealing compound to the unused end of the manifold, and fit the screw cap. For manifolds with flanges, fit a blanking flange with gasket.

To achieve optimum operation and minimize noise and vibration, it may be necessary to consider vibration dampening of the pump system.

Noise and vibration are generated by the rotations in the motor and pump and by the flow in pipes and fittings. The effect on the environment is subjective and depends on correct installation and the state of the other parts of the system.

If pump systems are installed in blocks of flats or the first consumer on the line is close to the pump system, we recommend that you fit expansion joints on the inlet and outlet pipes to prevent that vibrations are transmitted through the pipes.

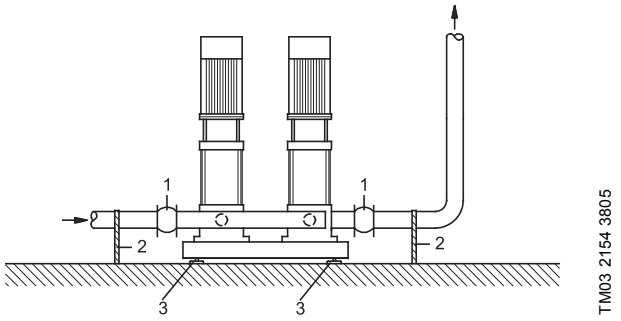
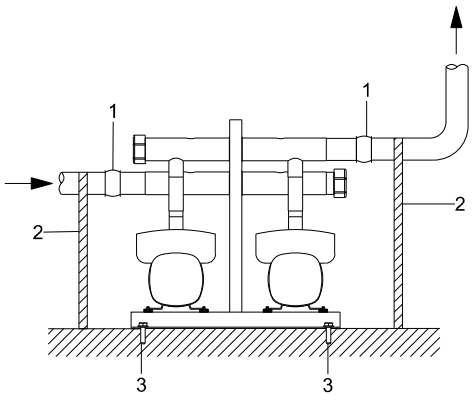


Fig. 1 Example showing the position of expansion joints, pipe supports and machine shoes

Pos.	Description
1	Expansion joint (and good location for isolating valves)
2	Pipe support
3	Machine shoe



TM04 9900 0211

Fig. 2 Example showing the position of expansion joints, pipe supports and mounting bolts

Pos.	Description
1	Expansion joint (and good location for isolating valves)
2	Pipe support
3	Mounting bolt

Expansion joints, pipe supports and machine shoes shown in figs. 1 and figs. 2, respectively, are not included in a standard pump system.

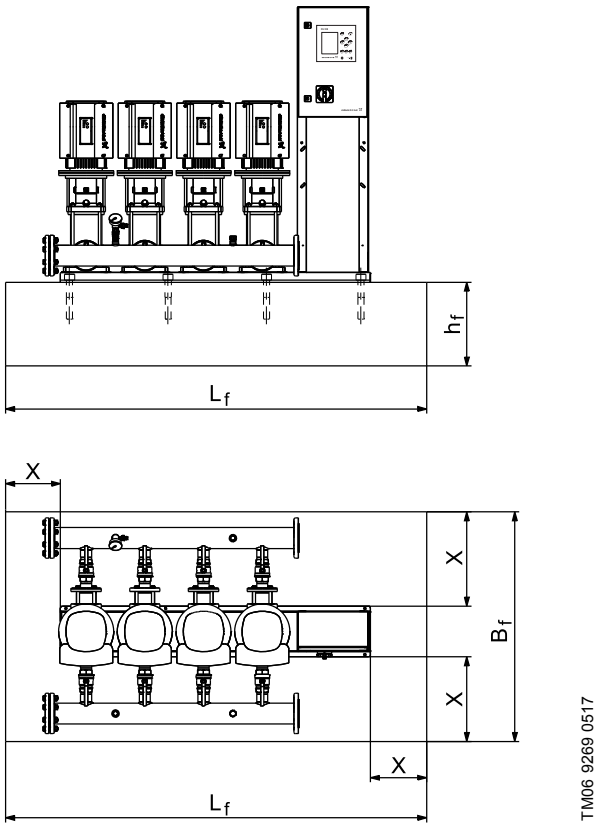
Tighten all nuts before startup.

Fasten the pipes to parts of the building to ensure that they cannot move or be twisted.

4.2.2 Foundation

We recommend that you install the pump system on a plane and rigid concrete foundation which is heavy enough to provide permanent support for the entire system. The foundation must be capable of absorbing any vibration, normal strain or shock.

The weight of a concrete foundation must be 1.5 times the weight of the pump system.



TM06 9269 0517

Fig. 3 Foundation

The minimum height of the foundation, h_f, is calculated as follows:

$$h_f = \frac{W_{pump} \times 1.5}{L_f \times B_f \times \delta_{concrete}}$$

The density δ of concrete is usually taken as 137 lb/ft^3 (2200 kg/m^3).

Variable	Unit
h_f	ft
W_{pump}	lb
L_f	ft
B_f	ft
$\delta_{concrete}$	lb/ft^3

4.2.3 Vibration dampers

To prevent the transmission of vibrations to buildings, we recommend that you isolate the pump system foundation from building parts by means of vibration dampers.

The right damper varies from installation to installation, and a wrong damper may increase the vibration level. Vibration dampers must therefore be sized by the supplier. If the pump system is installed on a base frame with vibration dampers, always fit expansion joints on the manifolds. This is important to prevent the pump system from "hanging" in the pipes.

4.2.4 Expansion joints

Fit expansion joints for these reasons:

- to absorb expansions or contractions in the pipes caused by changing liquid temperature
- to reduce mechanical strains in connection with pressure surges in the pipes
- to isolate mechanical structure-borne noise in the pipes (only rubber bellows expansion joints).

Do not install expansion joints to compensate for inaccuracies in the pipes such as center displacement of flanges.

Fit expansion joints at a distance of minimum 1 to 1 1/2 times the nominal flange diameter from the manifold on the inlet as well as on the outlet side. This prevents the development of turbulence in the expansion joints, resulting in better inlet conditions and a minimum pressure loss on the pressure side.

TM02 4981 1902 - TM02 4979 1902

Fig. 4 Examples of rubber bellows expansion joints without and with limiting rods

Expansion joints with limiting rods can be used to minimize the forces caused by the expansion joints. We always recommend that you use expansion joints with limiting rods for flanges larger than ANSI 4" (DN 100).

Anchor the pipes so that they do not stress the expansion joints and the pump. Follow the supplier's instructions and pass them on to advisers or pipe installers.

4.2.5 Prefilling of diaphragm tank, if applicable

If a diaphragm tank is connected to the system, prefill the tank with nitrogen to this pressure:

- 0.7 x the setpoint (Hydro MPC-E and F-systems)
- 0.9 x the setpoint (Hydro MPC-S systems).

Use nitrogen to avoid corrosion.

4.3 Electrical installation

CAUTION

Electric shock

Minor or moderate personal injury

- The electrical installation must be carried out by an approved person in accordance with local regulations and the relevant wiring diagram.
- Switch off the power supply and lock the main switch with a padlock to ensure that the power supply cannot be accidentally switched on.

- The electrical installation of the pump system must comply with enclosure class UL type 3R.
- Check that the power supply and frequency correspond to the values stated on the nameplate.
- Make sure that the conductor cross-section meets the specifications in the wiring diagram.

The connection of the electrical supply, transmitters and external monitoring equipment must be carried out by an authorized electrician in accordance with the NEC, local regulations and the Hydro MPC wiring diagram.

Ensure that the Hydro MPC controls and the pumps are suitable for the electricity supply on which they will be used. See section *14. Technical data*. Please read the wiring diagram carefully. According to the NEC, if the motors cannot be seen from the control panel, they must be fitted with a disconnect switch.

Any Hydro MPC that utilizes a variable frequency drive (E, ED, ES, EF, EDF, F) must be connected to an electrical supply with all phase lines electrically symmetrical with respect to ground. Grundfos recommend a four-wire wye electrical supply with line impedance between 0.5 - 3 %. If a variable frequency drive is connected to a delta transformer or if line impedance is not within the recommended 0.5 - 3 %, the drive may not operate correctly and may not provide optimum performance (excessive faults, erratic behavior, or complete failure). Grundfos does not recommend open delta power. Ask your power company or electrician to determine what type of electrical supply is present. Generator supplied power must meet public utility power quality standards.

5. Starting up the product

After having carried out the mechanical and electrical installation described in sections *4.2 Mechanical installation* and *4.3 Electrical installation*, proceed as follows:

1. Have a qualified person check for proper power supply and plumbing connections. Make sure the main power is off.
2. Check that the precharge pressure in the diaphragm tank is 0.7 times the required outlet pressure (setpoint). System pressure must not be applied to the tank connection during the tank precharge process. If water is supplied to the tank from the system, close the tank valve and bleed off the pressure in the tank before the pressurizing process.
3. Prime the system as follows:

- "Flooded inlet system" (pumps are flooded at least as high as the highest part of the pumps)
  - – Close all outlet manifold pump isolation valves.
  - – Open all inlet manifold pump isolation valves.
  - – Open the vent plug on all pumps.
  - – Leave the vents open until all air is removed from the pumps and only water is flowing from the vents.
  - – Close the vent plug on all pumps
- "Suction lift system" (the water source is below the pumps or does not flood the pumps to the highest point on the pumps).

A foot valve must be placed on the inlet piping at the water source (tank, etc).

Check valves must be installed on inlet manifolds and a priming line installed from outlet to inlet manifold for proper installation.

  - – Close all outlet manifold pump isolation valves.
  - – Open all inlet manifold pump isolation valves.
  - – If there is a fill point above the highest point of the pumps, you may fill the system from this point.
  - – If there is no fill point above the highest point of the pumps, remove the large vent plug on each pump. Fill each pump until the water is up to the vent plug.
  - – Replace the vent plugs.

4. Ensure all circuit breakers are in the "on" position.
5. Ensure the outlet manifold pump isolation valves are closed.
6. Switch on the main power.

When the power is switched on the pumps may start automatically.

7. If this is the first time the system has been powered on, the "Start-up wizard" may appear. Complete the "Start-up wizard" and proceed to step 9. If the wizard does not appear, please proceed to Step 8.
8. Run the "Start-up wizard" and perform the following:
   - – Move top line display to "Settings".If prompted for password, enter "1234".
   - – Move down to "Functions, CU 352" and press [OK].
   - – Move down to "Run wizard again" and press [OK].
9. Vent the system by opening the vent plug on each pump (as in Step 4, while the pump is running starting in step 18 of the "Start-up wizard"). Venting with the pumps running ensures all air is removed from the inlet piping. Do not run the system with the outlet manifold pump isolation valves closed more than five minutes to prevent over-heating of the pump liquid.
10. As the pumps stop, check the pump rotation. Repeat as necessary.

For better visibility remove a coupling guard. If the area is dark, a flashlight may be required.

CAUTION

Crushing of hands

Minor or moderate personal injury

- Do not touch the couplings while the pumps are turning. Replace all coupling guards after the rotation check.
- Disconnect the main power when removing and replacing the coupling guards

If the rotation is incorrect on any three-phase pumps, switch any 2 of the 3 power cables supplied to the control panel (L1, L2, L3). If this does not correct the rotation, contact Grundfos.

11. When you have vented the pumps and checked for correct rotation, the Hydro MPC is now ready for operation. With the outlet manifold isolation valves still closed, partially open each pump outlet isolation valve to allow water to enter into the outlet piping. Continue the process of filling the outlet piping until the outlet piping pressure is approximately at the desired setpoint pressure of the system.
12. Open pump outlet isolation valves completely. The system is now ready for operation.

It may be necessary to clear alarms in the fault log.

Installation and startup notes

5.1 Handling the product

The Hydro MPC pump systems with CR 125 or 155 pumps have eyebolts in the base frame. See fig. 5.

During handling, the lifting point must always be above the center of gravity of the pump system.

Each lifting strap must be at least 10ft (3 m) long.

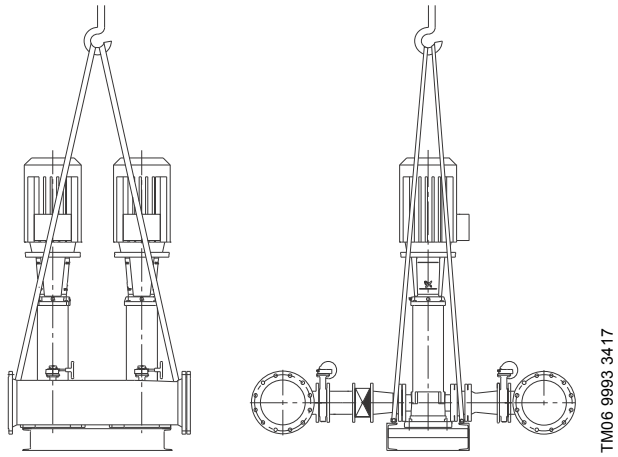


Fig. 5 Correct lifting of Hydro MPC XL

CAUTION

Overhead load

Minor or moderate personal injury

- When lifting the pump system, do not use the eyebolts of the motors.
- Do not lift the pump system by the manifolds.
- Do not stand on the manifolds.

CAUTION

Crushing of feet

Minor or moderate personal injury

- When lifting the pump system, do not use the eyebolts of the motors.
- Do not lift the pump system by the manifolds.
- Do not stand on the manifolds.

When lifting the pump system, only use suitable lifting equipment that is in good condition and approved for the weight. The weight is stated on the nameplate of the pump system.

Do not use chains for lifting pump systems with CR 125 or CR 155 pumps, as this may damage the motors.

5.2 Handling the product

Lift the pump systems with CM and CME pumps as shown in fig. 6.

During handling, the lifting point must always be above the center of gravity of the pump system.

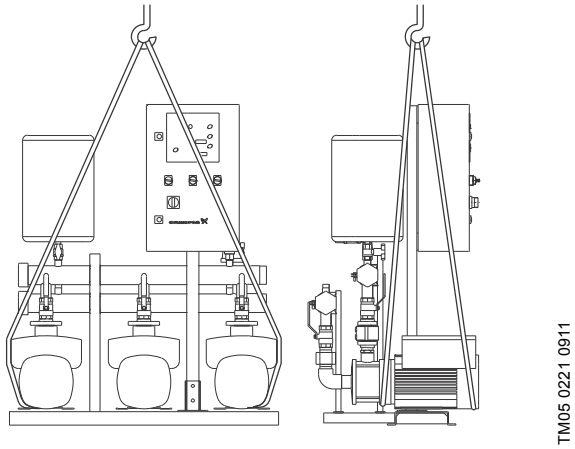


Fig. 6 Correct lifting of Hydro MPC CME with CM and CME pumps

CAUTION

Overhead load

Minor or moderate personal injury

- When lifting the pump system, do not use the eyebolts of the motors.
- Do not lift the pump system by the manifolds.
- Do not stand on the manifolds.

CAUTION

Crushing of feet

Minor or moderate personal injury

- When lifting the pump system, do not use the eyebolts of the motors.
- Do not lift the pump system by the manifolds.
- Do not stand on the manifolds.

When lifting the pump system, only use suitable lifting equipment that is in good condition and approved for the weight. The weight is stated on the nameplate of the pump system.

6. Product introduction

6.1 Product description for CR, CRE, CRI, CRIE

As standard, the pump systems consist of two to six CRI(E) or CR(E) pumps connected in parallel and mounted on a common base frame with a control cabinet and all necessary fittings.

A diaphragm tank must be included in some installations.

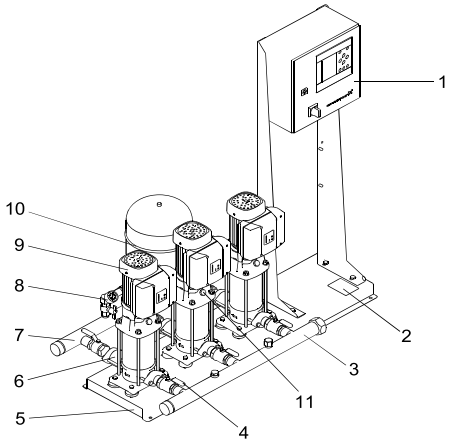


Fig. 7 Hydro MPC pump system

Pos.	Description	Quantity
1	Control cabinet	1
2	Nameplate	1
3	Inlet manifold, stainless steel	1
4	Isolating valve	2 per pump
5	Base frame, stainless steel	1
6	Non-return valve	1 per pump
7	Outlet manifold, stainless steel	1
8	Pressure transmitter and pressure gauge	1
9	Pump	2-6
10	Diaphragm tank	1
11	Vent plug	1 per pump

6.2 Control variant

The Hydro MPC pump systems are divided into three groups based on the control variant:

Control variant	Description
-E	Two to six electronically speed-controlled pumps. From 0.5 to 30 hp (0.37 to 22 kW), Hydro MPC-E is equipped with CRE pumps with integrated frequency converter. As from 40 hp (30 kW), Hydro MPC-E is equipped with CR pumps connected to Grundfos CUE frequency converters (one per pump).
-F	Two to six CR(I) pumps connected to a Grundfos CUE frequency converter. The speed-controlled operation alternates between the pumps.
-S	Two to six mains-operated CR(I) pumps

Design code E-I only uses CR pumps connected to Grundfos CUE frequency converters (one per pump).

See also section *7. Overview of control variants*.

Hydro MPC always include application-optimized software for setting the pump system to the application in question.

6.3 Product description for Hydro MPC CME

Hydro MPC CME is a range of factory-assembled pump systems, ready for installation and operation.

As standard, the pump systems consist of two and three pumps connected in parallel and mounted on a common base frame with a control cabinet and all necessary fittings.

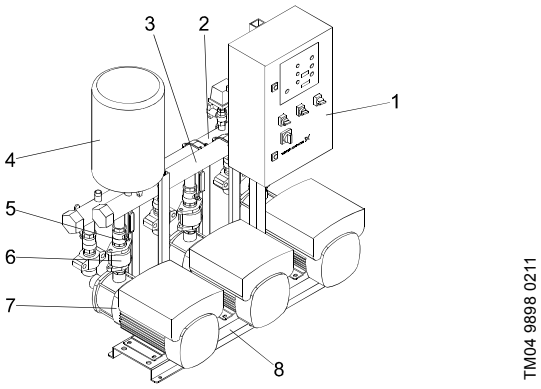


Fig. 8 Front view of Hydro MPC CME pump system with three CM(E) pumps

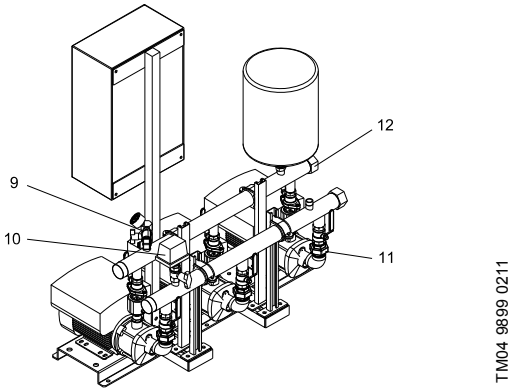


Fig. 9 Rear view of Hydro MPC CME pump system with three CM(E) pumps

Pos.	Description	Quantity
1	Control cabinet	1
2	Inlet manifold	1
3	Outlet manifold	1
4	Diaphragm tank (not included)	1
5	Isolating valve	2 per pump
6	Non-return valve	1 per pump
7	Pump	2-4
8	Base frame	1
9	Pressure transmitter and pressure gauge	1
10	Pressure switch or inlet pressure sensor	1
11	Oval flange (CME 3-10)	2 per pump
	Intermediate adapter (CME 15-25)	1 per pump
12	Screw cap or blanking flange	2

6.4 Identification

6.4.1 Nameplate

The nameplate of the pump system is fitted on the base frame. See position 2 in fig. 10.

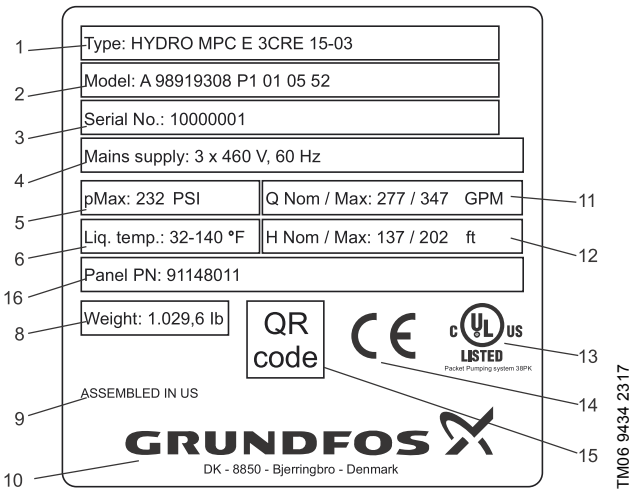


Fig. 10 Nameplate

Pos.	Description
1	Type designation
2	Model
3	Serial number
4	Supply voltage
5	Maximum operating pressure in PSI
6	Liquid temperature
7	Enclosure class
8	Weight in lb
9	Country of origin
10	Company logo
11	Maximum flow rate in GPM
12	Nominal head in ft
13	Approval mark
14	Approval mark
15	QR code
16	Panel part number

6.4.2 Software label

The software label is placed on the back of the CU 352 control unit.

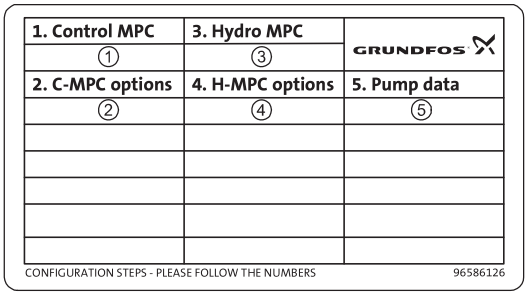


Fig. 11 Software label

Pos.	Description
1	Control MPC - GSC file number
2	Control MPC options - GSC file numbers
3	Hydro MPC - GSC file number*
4	Hydro MPC options - GSC file numbers*
5	Pump data - GSC file numbers**

* Applies only to pump systems.

** Applies only to CR and CRE pumps.

A GSC (Grundfos Standard Configuration) file is a configuration data file.

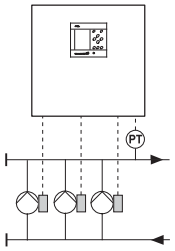
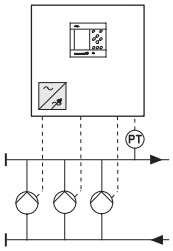
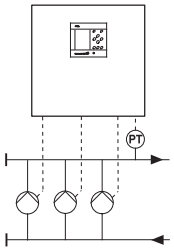
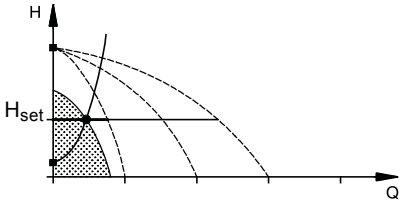
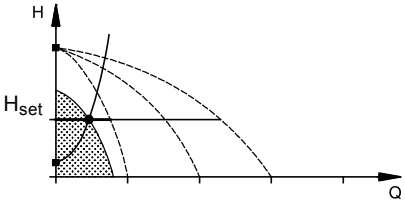
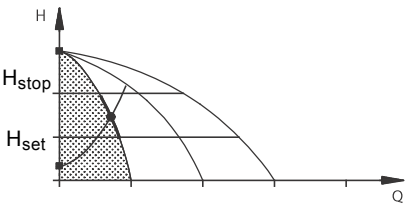
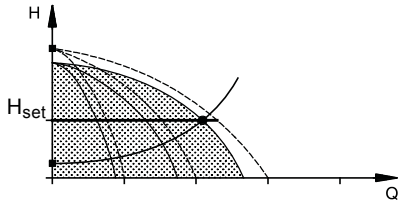
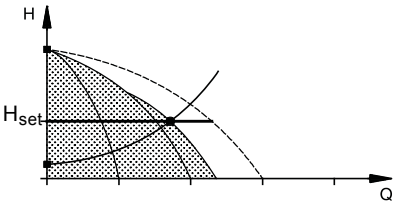
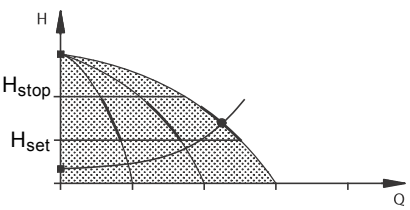
6.5 Type key

Code	Example	Hydro MPC	-E	3 CRE 15-03	3 x 460 V, 60 Hz
	Type range				
	System type				
E	All pumps, E-motor or CUE				
F	Fixed-speed pumps, one CUE				
S	Fixed-speed pumps				
X	Customized-system pumps				
Number of pumps with integrated frequency drive and pump type					
Number of fixed speed pumps and pump type					
Supply voltage, frequency					

* The control cabinet can be placed up to 6.6 ft (2 m) from the pumps.

7. Overview of control variants

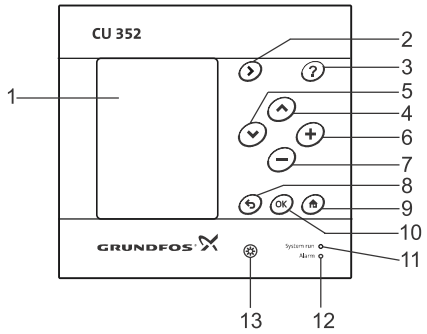
The table shows examples of systems.

Systems with speed-controlled pumps	Systems with pumps connected to one CUE frequency converter	Systems with mains-operated pumps
Hydro MPC-E	**Hydro MPC-F**	**Hydro MPC-S**
Hydro MPC pump system with three CR(I)E pumps.	System with three CR pumps connected to one Grundfos CUE frequency converter in the control cabinet. The speed-controlled operation alternates between the pumps.	System with three mains-operated CR(I) pumps.
 TM03 0993 0905	 TM03 1265 1505	 TM03 0999 0905
One CRE pump in operation.	One CR pump connected to one Grundfos CUE frequency converter in operation.	One mains-operated CR pump in operation.
 TM00 7995 2296	 TM00 7995 2296	 TM03 9204 3507
Three CRE pumps in operation.	One CR pump connected to one Grundfos CUE frequency converter and two mains-operated CR pumps in operation.	Three mains-operated CR pumps in operation.
 TM00 7996 2296	 TM00 7998 2296	 TM03 9003 3507
• Hydro MPC-E maintains a constant pressure through continuous adjustment of the speed of the pumps. • The system performance is adjusted to the demand through cutting in/out the required number of pumps and through parallel control of the pumps in operation. • Pump changeover is automatic and depends on load, operating hours and fault. • All pumps in operation will run at equal speed.	• Hydro MPC-F maintains a constant pressure through continuous adjustment of the speed of the CR pump connected to the Grundfos CUE frequency converter. The speed-controlled operation alternates between the pumps. • One CR pump connected to the Grundfos CUE frequency converter always starts first. If the pressure cannot be maintained by the pump, one or two mains-operated CR pumps will be cut in. • Pump changeover is automatic and depends on load, operating hours and fault.	• Hydro MPC-S maintains an almost constant pressure through cutting in/out the required number of pumps. • The operating range of the pumps will lie between H_{set} and H_{stop} (cut-out pressure). • Pump changeover is automatic and depends on load, operating hours and fault.

8. Operating panel

The operating panel in the front cover of the control cabinet features a display, a number of buttons and two indicator lights.

The operating panel enables manual setting and monitoring of the performance of the system.

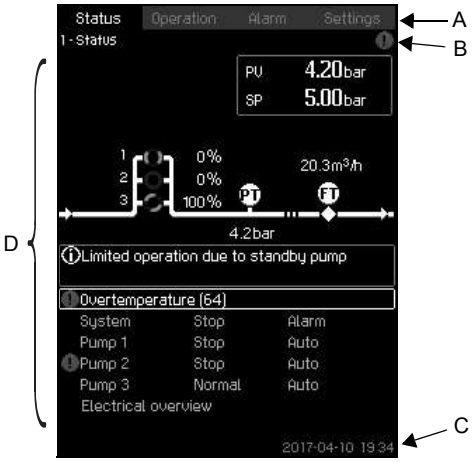


TM05 3043 0812

Fig. 12 Operating panel

Pos.	Description
1	Display
2	Arrow to the right
3	Help
4	Up
5	Down
6	Plus
7	Minus
8	Back
9	Home
10	OK
11	Indicator light, operation (green)
12	Indicator light, fault (red)
13	Brightness

8.1 Display



TM03 8947 0517

Fig. 13 Display design

8.1.1 Menu line

The menu line (A) is illustrated in fig. 13.

The display has four main menus:

Status	Indication of system status
Operation	Change of operating parameters such as setpoint
Alarm	Alarm log for fault finding
Settings	Change of settings (password option)

8.1.2 Top line

The top line (B) is illustrated in fig. 13. It shows the following:

- the display number and title (left side)
- the selected menu (left side)
- the symbol ⊗ in case of alarm (right side)
- the symbol ⚠ in case of warning (right side)
- the symbol ✎ if the service language has been selected (right side).

8.1.3 Graphical illustration

The graphical illustration (D) may show a status, an indication or other elements, depending on the position in the menu structure.

The illustration may show the entire system or part of it as well as various settings.

8.1.4 Scroll bar

If the list of illustration elements exceeds the display, the symbols ▲ and ▼ appear in the scroll bar to the right. Move up and down in lists with these symbols.

8.1.5 Bottom line

The bottom line (C) shows the date and time.

8.2 Buttons and indicator lights

The buttons (2 to 10 in fig. 12) on CU 352 are active when they are on.

8.2.1 Arrow to the right (2)

Press [>] to go to the next menu in the menu structure. If you press [>] when the menu "Settings" is highlighted, you will go to the menu "Status".

8.2.2 Help (3)

When this symbol is on, a help text applying to the display will appear if you press the button.

Close the text with ⮌.

8.2.3 Up and down (4 and 5)

Move up and down in lists with [∨] and [∧].

You can select a text with [OK] when it is in a box.

If a text is marked and you press [∧], the text above will be marked. If you press [∨], the text below will be marked.

If you press [∨] in the last line in the list, the first line will be marked.

If you press [∧] in the first line in the list, the last line will be marked.

8.2.4 Plus and minus (6 and 7)

Increase and reduce a value with [+] and [-]. Save with [OK].

8.2.5 Back (8)

Press ⮌ to go one display back in the menu.

If you have changed a value and press ⮌, the new value will not be saved. See also section *8.2.7 OK (10)*.

If you press [OK] before pressing ⮌, the new value will be saved. See also section *8.2.7 OK (10)*.

8.2.6 Home (9)

Press ⌂ to return to the menu "Status".

8.2.7 OK (10)

Use the button as an enter button.

The button is also used to start the setting of a value. If you have changed a value, press [OK] to save the change.

8.2.8 Indicator lights (11 and 12)

The operating panel incorporates a green and red indicator light.

The green indicator light will be on when the system is in operation and flash when the system has been set to stop.

The red indicator light will be on if there is an alarm or a warning. The fault can be identified from the alarm list.

8.2.9 Brightness (13)

You can change the brightness in the display with this button:

1. Press ☼.
2. Adjust the brightness with [+] and [-].

8.2.10 Back light

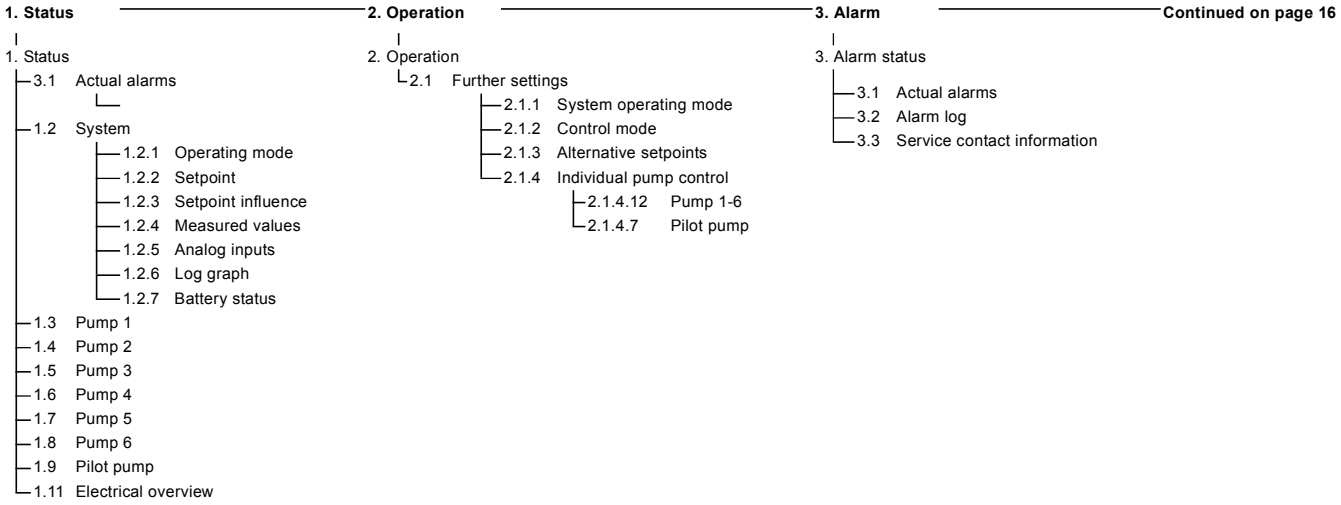
If no button is touched for 15 minutes, the back light of the display will be dimmed, and the first display in the menu "Status" will appear.

Press any button to re-activate the back light.

9. Functions

9.1 Tree of functions

The functions depend on the configuration of the system.



Key to the four menus

Status
This menu shows alarms, status of the system and a graph of logged data. **Note:** No settings can be made in this menu.
Operation
In this menu, you can set the basic parameters, such as setpoint, operating mode, control mode and individual pump control.
Alarm
This menu gives an overview of alarms and warnings. You can reset alarms and warnings in this menu.
Settings
In this menu, you can set various functions: • Primary controller PI controller, Alternative setpoints, External setpoint influence, Primary sensor, Secondary sensor, Clock program, Proportional pressure, S-system configuration, Setpoint ramp. • Pump cascade control Min. time between start/stop, Max. number of starts/hour, Number of standby pumps, Forced pump changeover, Pump test run, Pump stop attempt, Pump start and stop speed, Min. performance, Compensation for pump start-up time. • Secondary functions Stop function, Soft pressure build-up, Digital inputs, Analog inputs, Digital outputs*, Analog outputs, Counter inputs, Emergency run, Min., max. and user-defined duty, Pump curve data, Control source, Fixed inlet pressure, Flow estimation, Reduced operation, Multisensor settings. • Monitoring functions Dry-running protection, Min. pressure, Max. pressure, External fault, Limit 1 exceeded, Limit 2 exceeded, Pumps outside duty range, Pressure relief, Log values, Fault, primary sensor, Non-return valve. • Functions, CU 352 Display language, Units, Date and time, Password, Ethernet, GENIbus number Software status, Display 1, Display 2, Display 3.

* If an IO 351 is installed.

Continued from page 15

1-> **4. Settings**

- 4.1 Primary controller
  - 4.1.1 PI controller
  - 4.1.2 Alternative setpoints
    - 4.1.2.1 Alternative setpoints 2-7
  - 4.1.3 External setpoint influence
    - 4.1.3.1 Input value to be influenced by
      - 4.1.3.2 Setting of influence function
  - 4.1.4 Primary sensor
  - 4.1.5 Secondary sensor
  - 4.1.6 Clock program
  - 4.1.7 Proportional pressure
  - 4.1.8 S-system configuration
  - 4.1.9 Setpoint ramp
- 4.2 Pump cascade control
  - 4.2.1 Min. time between start/stop
Max. number of starts/hour
  - 4.2.3 Standby pumps
  - 4.2.4 Forced pump changeover
  - 4.2.5 Pump test run
  - 4.2.7 Pump stop attempt
  - 4.2.8 Pump start and stop speed
  - 4.2.9 Min. performance
  - 4.2.10 Compensation for pump start-up time
- 4.3 Secondary functions
  - 4.3.1 Stop function
    - 4.3.1.1 Stop parameters
  - 4.3.3 Soft pressure build-up
  - 4.3.5 Emergency run
  - 4.3.7 Digital inputs
    - Function, DI1 (CU 352) - DI3, [10, 12, 14]
    - Function, DI1 (IO 351-41) - DI9, [10-46]
    - Function, DI1 (IO 351-42) - DI9, [10-46]
  - 4.3.8 Analog inputs
    - Setting, AI1 (CU 352), [51] - AI3, [51, 54, 57]
      - Function, AI1 (CU 352) - AI3 [51, 54, 57]
    - Setting, AI1 (IO 351-41), [57] - AI2 [57, 60]
      - Function, AI1 (IO 351-41) - AI2 [57, 60]
    - Setting, AI1 (IO 351-42), [57] - AI2 [57, 60]
      - Function, AI1 (IO 351-42) - A2 [57, 60]
  - 4.3.9 Digital outputs
    - DO1 (CU 352), [71] is signalling - DO2 [71, 74]
    - DO1 (IO 351-41), [77] is signalling - DO7 [77-88]
    - DO1 (IO 351-42), [77] is signalling - DO7 [77-88]
  - 4.3.10 Analog outputs
    - AO1 (IO 351-41) [18] - AO3 [18, 22, 26]
    - AO1 (IO 351-42) [18] - AO3 [18, 22, 26]
  - 4.3.11 Counter inputs
  - 4.3.14 Min., max. and user-defined duty
    - 4.3.14.1 Min. duty
    - 4.3.14.2 Max. duty
    - 4.3.14.3 Set user-defined duty
  - 4.3.19 Pump curve data
    - 4.3.23 Flow estimation
  - 4.3.20 Control source
  - 4.3.22 Fixed inlet pressure
  - 4.3.23 Flow estimation
  - 4.3.24 Reduced operation
  - 4.3.25 Multisensor settings
- 4.4 Monitoring functions
  - 4.4.1 Dry-running protection
    - 4.4.1.1 Pressure/level switch
    - 4.4.1.2 Measurement, inlet pressure
    - 4.4.1.3 Measurement, tank level
  - 4.4.2 Min. pressure
  - 4.4.3 Max. pressure
  - 4.4.4 External fault
  - 4.4.5 Limit 1 exceeded
  - 4.4.6 Limit 2 exceeded
  - 4.4.7 Pumps outside duty range
  - 4.4.8 Pressure relief
  - 4.4.9 Log values
  - 4.4.10 Fault, primary sensor
  - 4.4.11 Non-return valve
- 4.5 Functions, CU 352
  - Change language to the service language (English)
  - Run wizard again
  - 4.5.1 Display language
  - 4.5.2 Units
    - 4.5.2.1 Pressure
    - 4.5.2.2 Differential pressure
    - 4.5.2.3 Head
    - 4.5.2.4 Level
    - 4.5.2.5 Flow rate
    - 4.5.2.6 Volume
    - 4.5.2.7 Specific
    - 4.5.2.8 Temperature
    - 4.5.2.9 Power
    - 4.5.2.10 Energy
  - 4.5.3 Date and time
  - 4.5.4 Password
  - 4.5.5 Ethernet
  - 4.5.6 GENIbus number
  - 4.5.9 Software status

9.2 Overview

9.3 Description of functions

The description of functions is based on the four main menus of the CU 352 control unit:

- Status
- Operation
- Alarm
- Settings.

The functions apply to all control variants unless otherwise stated.

9.4 Status (1)

The first status display is shown below. This display is shown when the power is switched on, and it appears if the buttons of the operating panel remain untouched for 15 minutes.

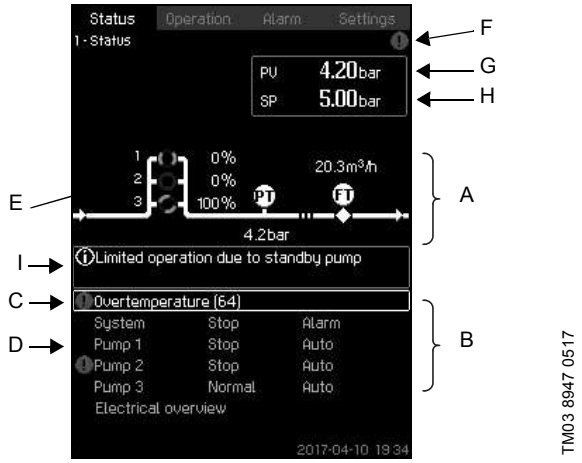


Fig. 14 Status

Description

No settings can be made in this menu.

The actual value (process value, PV) of the control parameter, usually the outlet pressure, is shown in the upper right corner (G) together with the selected setpoint (SP) (H).

The upper half of the display (A) shows a graphic illustration of the pump system. The selected measuring parameters are shown with sensor symbol and actual value.

In MPC-E systems where the differential pressure across the pumps and pump curve data are known, the display shows the estimated flow rate when the flow rate and speed of the pumps are within a range where it is possible to estimate the flow rate.

≈ : This indicates that the flow rate is an estimated value.

The estimated flow rate may differ from a measured value.

In the middle of the display, an information field (I) is shown if any of the following events occurs:

- Limited operation due to standby pump
- Proportional-pressure influence active
- External setpoint influence active
- Alternative setpoint active
- Low flow boost active
- Pressure relief active
- Clock program active
- Remote-controlled via GENI (RS-485)
- Limited due to reduced operation
- Stopped due to low flow.

The lower display half (B) shows the following:

- the most recent active alarm, if any, and the fault cause with the fault code in brackets
- system status with actual operating mode and control source
- pump status with actual operating mode.

If a fault has occurred, the warning symbol ⚠ or alarm symbol ⊗ is shown in the line (C) together with the cause and fault code, for instance "Overtemperature (64)".

If the fault is related to one of the pumps, one of the symbols ⚠ or ⊗ is also shown in front of the status line (D) of the pump in question. At the same time, the pump status indicator (E) changes color to either yellow or red as described in the table below. The symbol ⚠ or ⊗ is shown to the right in the top line of the display (F). As long as a fault is present, this symbol is shown in the top line of all displays.

To open a menu line, select the line with [∨] or [∧] and press [OK].

The display allows you to open status displays showing the following:

- actual alarms
- system status
- status of each pump.

Description of pump status

Pump status indicator	Description
Rotating, green	The pump is running.
Permanently green	The pump is ready (not running).
Rotating, yellow	Warning. The pump is running.
Permanently yellow	Warning. The pump is ready (not running).
Permanently red	Alarm. The pump is stopped.

9.4.1 Actual alarms (3.1)

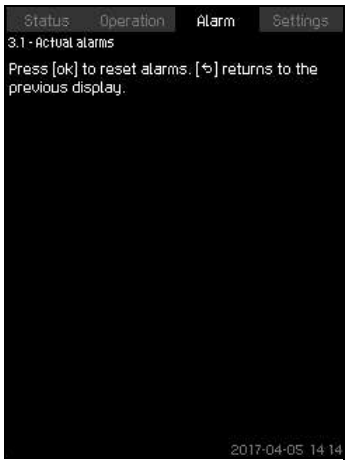


Fig. 15 Actual alarms

Description

This display shows active unreset alarms and warnings.

For further information, see sections *9.6.2 Actual alarms (3.1)* and *9.6.3 Alarm log (3.2)*.

9.4.2 System (1.2)

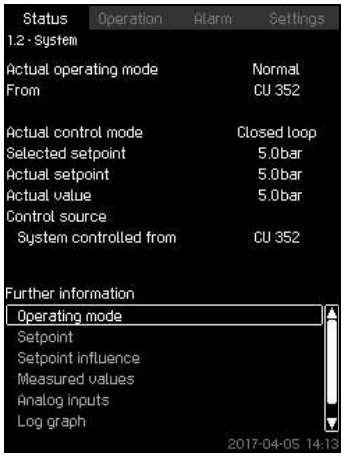


Fig. 16 System

Description

This display shows the operational state of the system. Go to subdisplays for further details.

The display allows you to open displays about the following:

- Operating mode
- Setpoint
- Setpoint influence
- Measured values
- Analog inputs
- Log graph
- Battery status.

9.4.3 Operating mode (1.2.1)

Fig. 17 Operating mode

Description

This display shows the operating mode of the system and from where it is controlled.

Operating modes

The system has six operating modes:

1. Normal
   – The pumps adapt their performance to the requirement.
2. Max.
   – The pumps run at a constant high speed. Normally, all pumps run at maximum speed.
3. User-defined
   – The pumps run at a constant speed set by the user. It is usually a performance between "Max." and "Min.".
4. Min.
   – The pumps run at a constant low speed. Normally, one pump is running at a speed of 70 %.
5. Stop
   – All pumps have been stopped.
6. Emergency run
   – The pumps run according to the setting made in display *Emergency run (4.3.5)*.

The performance required in these operating modes can be set in the menu "Settings":

- Max.
- Min.
- User-defined
- Emergency run.

See sections *9.7.37 Min., max. and user-defined duty (4.3.14)* and *9.7.26 Emergency run (4.3.5)*.

The actual operating mode can be controlled from four different sources:

- Fault
- External signal
- CU 352
- Bus.

Control source

You can set the system to remote control via an external bus (option). In this case, you must set a setpoint and an operating mode via the bus.

In the menu "Settings", you can select whether CU 352 or the external bus is to be the control source.

The status of this setting is shown in the display "Operating mode".

9.4.4 Setpoint (1.2.2)

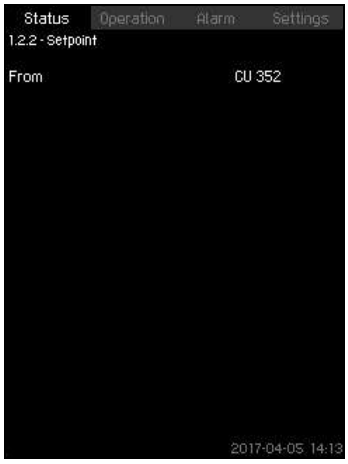


Fig. 18 Setpoint

Description

This display shows the selected setpoint and whether it comes from CU 352 or an external bus.

The display also shows all seven possible setpoints from CU 352 (for closed- and open-loop control). At the same time, the selected setpoint is shown.

As it is a status display, no settings can be made.

You can change the setpoints in the menus "Operation" or "Settings". See section *9.7.3 Alternative setpoints (4.1.2)*.

9.4.5 Setpoint influence (1.2.3)

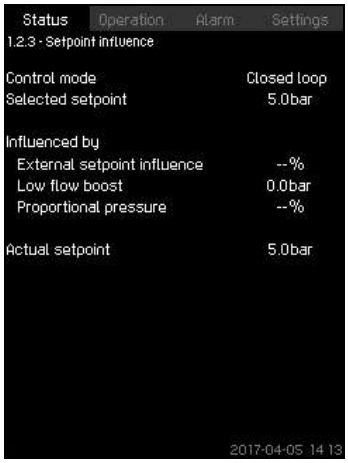


Fig. 19 Setpoint influence

Description

The selected setpoint can be influenced by parameters. The parameters are shown as percentage from 0 to 100 % or as a pressure measured in psi. They can only reduce the setpoint, as the influence in percentage divided with 100 is multiplied with the selected setpoint:

Actual setpoint (SP) = selected setpoint x influence (1) x influence (2) x etc.

The display shows the parameters influencing the selected setpoint and the percentage or value of influence.

You can set some of the possible parameters in the display *External setpoint influence (4.1.3)*. The parameter "Low flow boost" is set as a start/stop band as a percentage of the setpoint set in the display *Stop function (4.3.1)*. The parameter is set as a percentage in the display *Proportional pressure (4.1.7)*.

Finally, the resulting actual setpoint (SP) is shown.

9.4.6 Measured values (1.2.4)

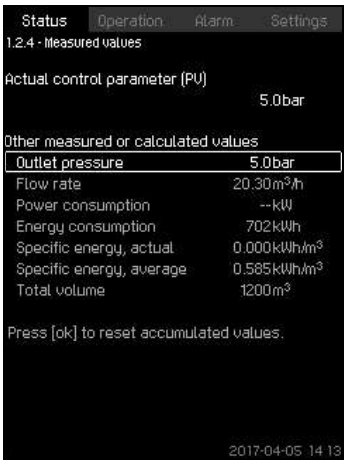


Fig. 20 Measured values

Description

This display gives a general status of all measured and calculated parameters. In MPC-E systems with a flowmeter, the specific energy is shown as an average value and actual value (mean value over the last minute). The average value is based on the accumulated flow shown as total volume. The total volume and specific energy average can be reset in this display.

The lines "Power consumption" and "Energy consumption" are only shown in MPC-E systems.

9.4.7 Analog inputs (1.2.5)

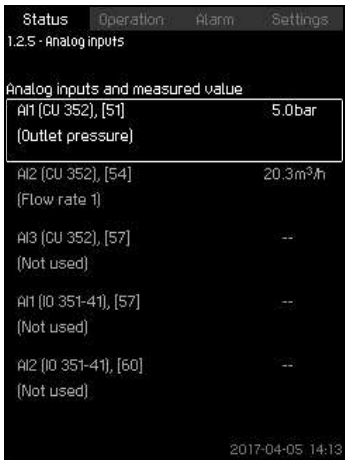


Fig. 21 Analog inputs

Description

This display shows an overview of the analog inputs and the measured values of each input. See sections *9.7.29 Analog inputs (4.3.8)*, *9.7.30 Analog inputs (4.3.8.1 to 4.3.8.7)* and *9.7.31 Analog inputs and measured value (4.3.8.1.1 - 4.3.8.7.1)*.

9.4.8 Log graph (1.2.6)

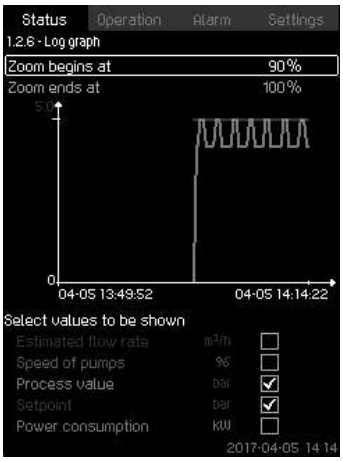


Fig. 22 Log graph

Description

In this display, you can see logged data stored in the controller. Select log values in the display *Log values (4.4.9)*. Various values can be shown, and the time scale can be changed.

Setting via the operating panel

Status > System > Log graph

1. Set as a percentage:
   - Zoom begins at
   - Zoom ends at
2. Select values to be shown.

9.4.9 Battery status (1.2.7)

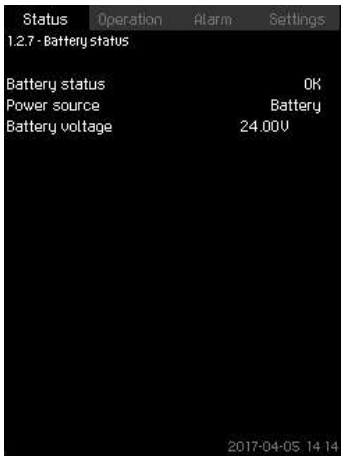


Fig. 23 Battery status

Description

Here you can see the status of the backup battery, if installed.

9.4.10 Pump 1-6, Pilot pump (1.3 - 1.10)

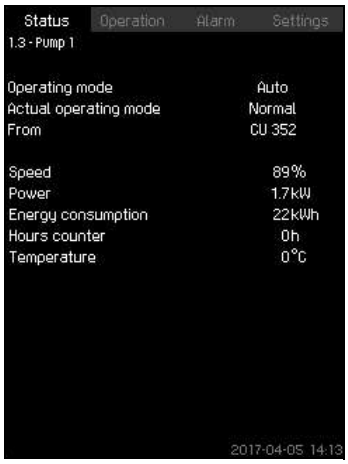


Fig. 24 Pump 1

Description

This display shows the operational state of the individual pumps.

The displays for the pilot pump are only shown if such pumps are installed.

The pumps can have different operating modes:

- Auto

  Together with the other pumps in automatic operation, the pump is controlled by the PI controller which ensures that the system delivers the required performance.
- Manual

  The pump is not controlled by the PI controller. In manual operation, the pump has one of the following operating modes:

  – Max.
  The pump runs at a set maximum speed. (This operating mode can only be selected for variable-speed pumps.)

  – Normal
  The pump runs at a set speed.

  – Min.
  The pump runs at a set minimum speed. (This operating mode can only be selected for variable-speed pumps.)

  – Stop
  The pump has been forced to stop.

Besides information about the operating mode, you can read various parameters in the status display, such as these:

- Actual operating mode
- Control source
- Speed (only 0 or 100 % are shown for mains-operated pumps)
- Power (only MPC-E/-EC)
- Energy consumption (only MPC-E/-EC)
- Operating hours
- Temperature.

9.5 Operation (2)

In this menu, you can set the basic parameters, such as setpoint, operating mode, control mode and individual pump control.

9.5.1 Operation (2)

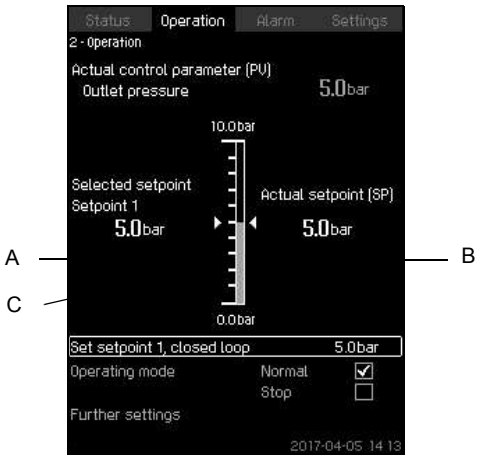


Fig. 25 Operation

Description

The column shows the setting range. In closed-loop control, it corresponds to the range of the primary sensor, here 0-145 psi (0-10 bar). In open-loop control, the setting range is 0-100 %.

At the left hand of the column, you can see the selected setpoint 1 (A), that is the value set in the display. At the right hand of the column, you can see the actual setpoint (B), that is the setpoint acting as reference for the PI controller. If no kind of external setpoint influence has been selected, the two values will be identical. The measured value (outlet pressure) is shown as the grey part of the column (C). See sections *9.7.5 External setpoint influence (4.1.3)* and *9.7.6 Setting of influence function (4.1.3.2)*.

Below the display is a menu line for setting of setpoint 1 and selection of operating mode, including the operating modes "Normal" and "Stop". You can select further settings: "System operating mode", "Control mode", "Alternative setpoints" and "Individual pump control".

Setting range

Setpoint:

Closed-loop control: Measuring range of the primary sensor

Open-loop control: 0-100 %.

Setting via the operating panel

Setpoint

- Operation > Set setpoint 1, open loop / Set setpoint 1, closed loop.

Set the value.

Operating mode

- Operation

Select: Normal or Stop.

Further settings

- Operation > Further settings.

Select one of the settings below:

- System operating mode (see section *9.5.2*).
- Control mode (see section *9.5.3*).
- Alternative setpoints (see section *9.5.4*).
- Individual pump control (see section *9.5.6*).

Factory setting

The setpoint is a value suitable for the system in question. The factory setting may have been changed in the startup menu.

9.5.2 System operating mode (2.1.1)

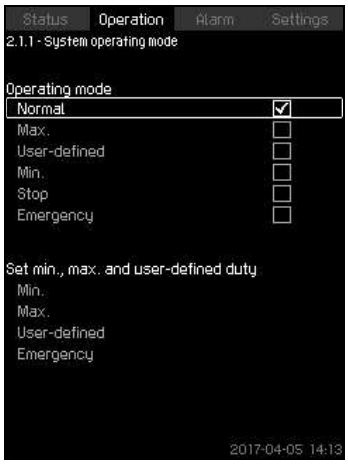


Fig. 26 System operating mode

Description

The system can be set to six different operating modes. "Normal" is the typical setting. See section *9.4.3 Operating mode (1.2.1)*.

You can set the performance of the operating modes in this menu:

- Min.
- Max.
- User-defined
- Emergency.

Setting range

- Normal
- Max.
- Min.
- User-defined
- Stop
- Emergency.

Setting via the operating panel

- Operation > Further settings > System operating mode > Operating mode.

Select the desired line at the bottom of the display to set the performance for "Max.", "Min.", "User-defined" and "Emergency" run. See sections *9.7.37 Min., max. and user-defined duty (4.3.14)* and *9.7.26 Emergency run (4.3.5)*.

Factory setting

Normal.

9.5.3 Control mode (2.1.2)

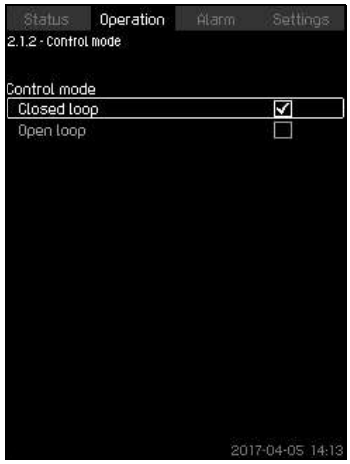


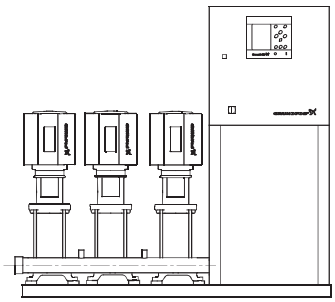
Fig. 27 Control mode

Description

There are two control modes, namely closed and open loop.

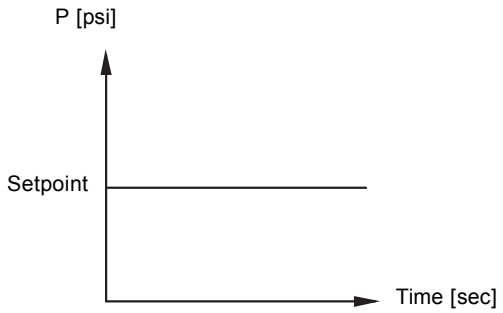
Closed loop

The typical control mode is "Closed loop" where the built-in PI controller ensures that the system reaches and maintains the selected setpoint. The performance is based on the setpoint set for closed loop. See figs 28 and 29.



TM03 2231 3905

Fig. 28 Pump system controlled by built-in PI controller (closed loop)



TM03 2390 4105

Fig. 29 Regulation curve for closed loop

Setting via the operating panel

- Operation > Further settings > Control mode > Closed loop.

Set the setpoint. See sections *9.5.4 Alternative setpoints (2.1.3)* and *9.5.1 Operation (2)*.

Open loop

In open-loop control mode, the pumps run at a fixed speed. The pump speed is calculated from the performance set by the user (0-100 %). The pump performance in percentage is proportional with the flow rate.

Open-loop control mode is usually used when the system is controlled by an external controller which controls the performance via an external signal. The external controller could for instance be a building management system connected to the MPC system. In such cases MPC is like an actuator. See figs 30 and 31.

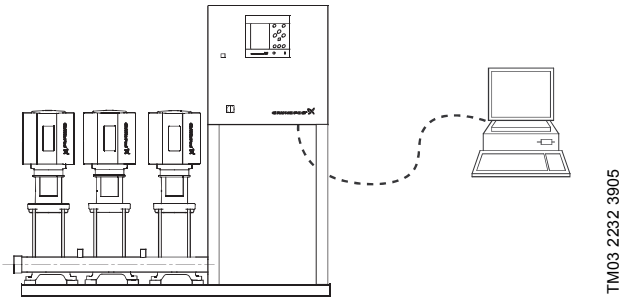


Fig. 30 Pump system with external controller (open loop)

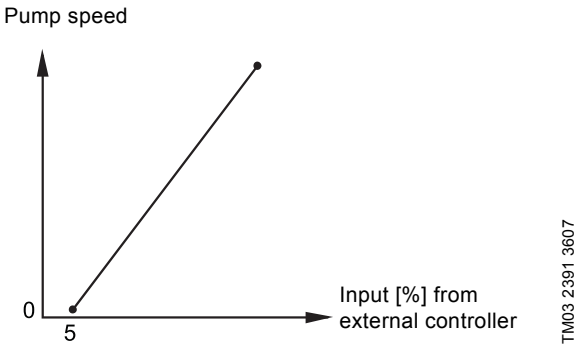


Fig. 31 Regulation curve for open loop

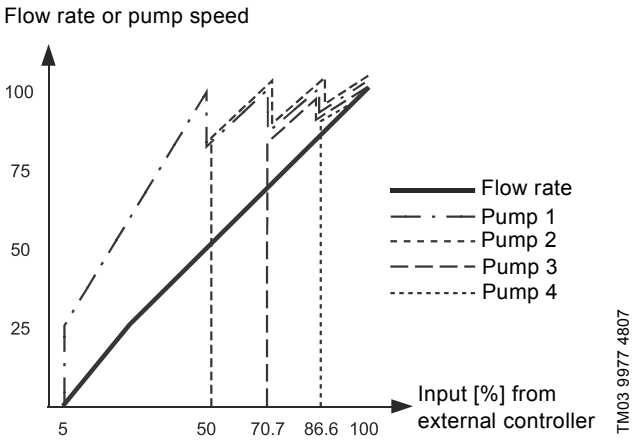


Fig. 32 Regulation curve for MPC-E system in open loop

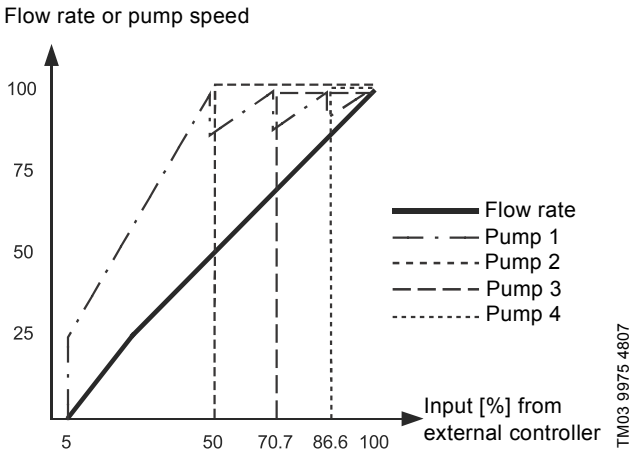


Fig. 33 Regulation curve for MPC-F system in open loop

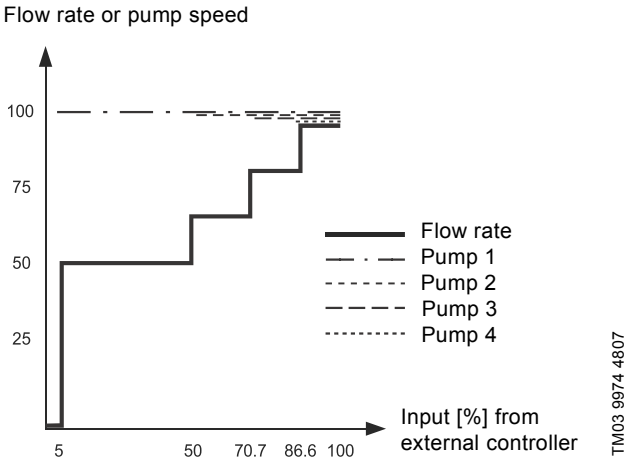


Fig. 34 Regulation curve for MPC-S system in open loop

Setting range

These settings must be made in connection with open loop:

- Open loop
- Set setpoint 1, open loop
- External setpoint influence
- Normal.

Setting via the operating panel

Proceed as follows to set an external control source to control the system:

- Operation > Further settings > Control mode.
- Select: Open loop.

1. Press ↩ x 2.
2. Select: Stop
3. Set to 100 %: Set setpoint 1, open loop.
4. Settings > Primary controller > External setpoint influence > Go to setting of analog input.
5. Select analog input and range.
6. Select:

- Measured input value. Display 4.3.8.1.1 appears.
- Select: 0-100 % signal.

7. Press ↩.
8. Set the minimum and maximum sensor value.
9. Press ↩ x 2.
10. Select:

- Input value to be influenced by
- 0-100 % signal.

11. Press ↩.
12. Select: Set the influence function. See also section *9.7.6 Setting of influence function (4.1.3.2)*.
13. Set the number of points.
14. Set for Point 1:

- External input value
- Reduce setpoint to

15. Repeat step 14 for all selected points.
16. Press ↩.
17. Set as seconds: Filter time.
18. Select: Enabled.
19. Press ↩ x 2.
20. Select:

- Operation
- Normal.

The pump system can now be controlled by an external controller.

Factory setting

Closed loop.

9.5.4 Alternative setpoints (2.1.3)

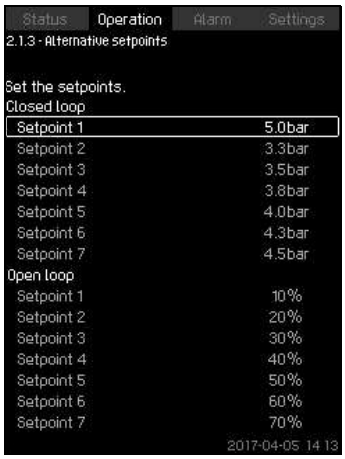


Fig. 35 Alternative setpoints

Description

In addition to the primary setpoint 1 (shown in display 2 in menu "Operation"), you can set six alternative setpoints for closed-loop control mode. Furthermore, you can set seven setpoints for open-loop control mode.

You can activate one of the alternative setpoints by means of external contacts. See sections *9.7.3 Alternative setpoints (4.1.2)* and *9.7.4 Alternative setpoints 2-7 (4.1.2.1 - 4.1.2.7)*.

Setting range

The setting range of setpoints for closed-loop control mode depends on the range of the primary sensor. See section *9.7.7 Primary sensor (4.1.4)*.

In open-loop control mode, the setting range is 0-100 %.

Setting via the operating panel

- Operation > Further settings > Alternative setpoints.

Set the setpoint.

Factory setting

Setpoint 1 for closed-loop control mode is a value suitable for the system in question.

The alternative setpoints for closed-loop control mode are 44 psi (3 bar).

All setpoints for open-loop control mode are 70 %.

9.5.5 Individual pump control (2.1.4)

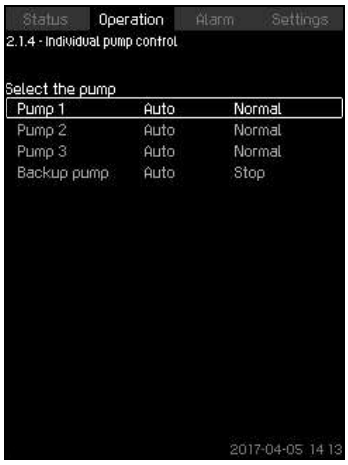


Fig. 36 Individual pump control

Description

You can change the operating mode from automatic operation to one of the manual operating modes.

Auto

The pumps are controlled by the PI controller, ensuring that the system delivers the required performance.

Manual

The pump is not controlled by the PI controller, but set to one of the following manual operating modes:

- Max.
  - The pump runs at a set maximum speed. (This operating mode can only be selected for variable-speed pumps.)
- Normal
  - The pump runs at a set speed.
- Min.
  - The pump runs at a set minimum speed. (This operating mode can only be selected for variable-speed pumps.)
- Stop
  - The pump has been forced to stop.

Pumps in manual operation are not part of the normal pump cascade and speed control. The manual pumps are a "disturbance" of the normal operation of the system.

If one or more pumps are in manual operation, the system may not be able to deliver the set performance.

There are two displays for the function. In the first display, select the pump to be set, and in the next display, select the operating mode.

Setting range

All pumps can be selected.

Setting via the operating panel

Operation > Further settings > Individual pump control.

9.5.6 Pump 1-6 (2.1.4.1 - 2.1.4.6)

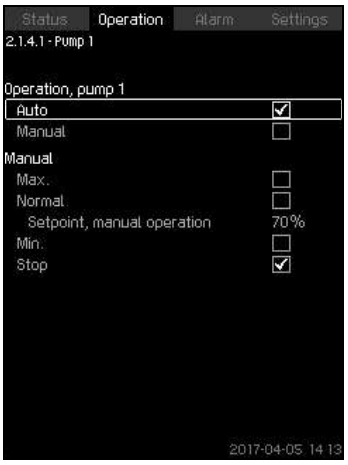


Fig. 37 Pump 1-6

Description

This display is shown for the individual pumps and it allows you to set an operating mode.

Setting range

You can select "Auto" or "Manual" as well as the operating mode of the pump for manual operation - "Max.", "Normal", "Min." or "Stop". For mains-operated pumps, you can only select "Normal" or "Stop".

Setting via the operating panel

- Operation > Further settings > Individual pump control.

1. Select pump.
2. Select resetting: Auto or Manual.
3. Manual: Select operating mode.
   Normal: Set the setpoint.

Factory setting

Auto.

9.5.7 Operation, pilot pump (2.1.4.7)

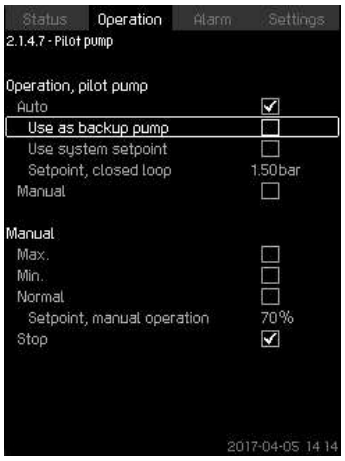


Fig. 38 Operation, pilot pump

Description

This display is only shown in systems that have been configured with a pilot pump.

You can set the operating mode and setpoint for the pilot pump.

Setting range

Auto

Select this mode if the pilot pump is to be used as a backup pump. If the pilot pump is selected as a backup pump, it will start if the main pumps are running at 100 % speed and still cannot reach or maintain the setpoint.

The setpoint of the pilot pump can either be set to the same value as that of the main pumps by selecting "Use system setpoint" or to another value.

Manual

Max., Normal, Min., Stop.

Setting via the operating panel

- Operation > Further settings > Individual pump control > Pilot pump.

Select resetting: Auto or Manual.

Auto

1. Select if the pump is also to be used as backup pump (only possible if the system does not already incorporate a backup pump).
2. Select "Use system setpoint" or enter a setpoint.

Manual

1. Select operating mode.
2. Normal: Set the setpoint.

Factory setting

Auto.

Use system setpoint.

9.6 Alarm (3)

This menu gives an overview of alarms and warnings.

You can reset alarms.

9.6.1 Alarm status (3)

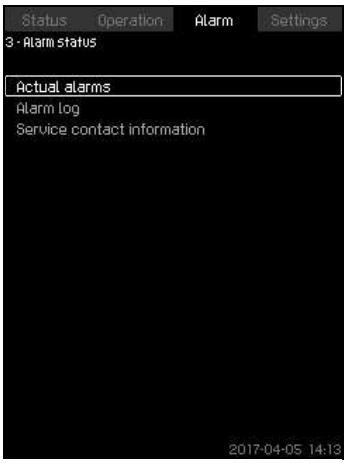


Fig. 39 Alarm status

Description

A fault in the system or one of the components monitored can cause an alarm ⊗ or a warning ⚠. Besides the fault signal via the alarm and warning signal relay and the red indicator light on CU 352, an alarm can also cause a change of operating mode, for instance from "Normal" to "Stop". A warning only causes a fault indication.

The table shows the possible causes of fault together with an alarm code, and whether they result in an alarm or a warning. It also shows to what operating mode the system will change in case of alarm, and whether restarting of the system and resetting of the alarm is manual or automatic.

The table also shows that the reaction to some of the fault causes mentioned can be set in the menu "Settings". See sections *9.7.25 Soft pressure build-up (4.3.3)* and *9.7.48 Monitoring functions (4.4)* to *9.7.58 Pressure relief (4.4.8)*.

Fault	Warning (⚠) Alarm (⊗)	Change of operating mode to	Resetting of alarm, restarting	Set in the menu "Settings"	Alarm code
Water shortage	⚠		Manual/automatic	X	206
Water shortage	⊗	Stop	Manual/automatic	X	214
Pressure high	⊗	Stop	Manual/automatic	X	210
Pressure low	⚠		Manual/automatic	X	211
	⊗	Stop	Manual/automatic		
Pressure relief	⚠		Manual/automatic	X	219
Alarm, all pumps	⊗	Stop	Automatic		203
External fault	⚠		Manual/automatic	X	3
	⊗	Stop	Manual/automatic		
Dissimilar sensor signals	⚠		Automatic		204
Fault, primary sensor	⊗	Stop	Automatic		89
Fault, sensor	⚠		Automatic		88
Communication fault	⚠		Automatic		10
Phase failure	⚠		Automatic		2
Undervoltage, pump	⚠		Automatic		7, 40, 42, 73
Overvoltage, pump	⚠		Automatic		32
Overload, pump	⚠		Automatic		48, 50, 51, 54
Motor temperature too high	⚠		Automatic		64, 65, 67, 70
Other fault, pump	⚠		Automatic		76, 83
Internal fault, CU 352	⚠		Automatic		83, 157
Internal fault, IO 351	⊗	Stop	Automatic		72, 83, 157
VFD not ready	⚠		Automatic		213
Fault, Ethernet	⚠		Automatic		231, 232
Limit 1 exceeded	⚠ ⊗		Manual/automatic	X	190
Limit 2 exceeded	⚠ ⊗		Manual/automatic	X	191
Pressure buildup fault	⚠ ⊗		Manual/automatic	X	215
Pumps outside duty range	⚠		Manual/automatic	X	208
Fault, pilot pump	⚠		Automatic		216
Multisensor fault	⊗		Automatic		143
Multisensor value exceeds limits	⚠		Automatic	X	87
Signal fault, secondary sensor	⚠		Automatic	X	93
Non-return valve fault	⚠		Manual/automatic	X	209
Non-return valve fault	⊗		Manual/automatic	X	209

9.6.2 Actual alarms (3.1)

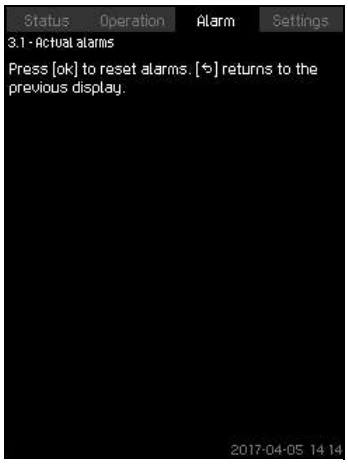


Fig. 40 Actual alarms

Description

This submenu shows the following:

- Warnings ⚠ caused by faults that still exist.
- Warnings ⚠ caused by faults that have disappeared, but the warning requires manual resetting.
- Alarms ⊗ caused by faults that still exist.
- Alarms ⊗ caused by faults that have disappeared, but the alarm requires manual resetting.

All warnings and alarms with automatic resetting are automatically removed from the menu when the fault has disappeared.

Alarms requiring manual resetting can be reset in this display by pressing [OK]. An alarm cannot be reset until the fault has disappeared.

For every warning or alarm, the following is shown:

- Whether it is a warning ⚠ or an alarm ⊗.
- Where the fault occurred: System, Pump 1, Pump 2, etc.
- In case of input-related faults, the input is shown.
- The cause of the fault and the alarm code in brackets, such as "Water shortage (214)".
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time are shown as "--...--".

The most recent warning or alarm is shown at the top of the display.

9.6.3 Alarm log (3.2)

The alarm log can store up to 24 warnings and alarms.

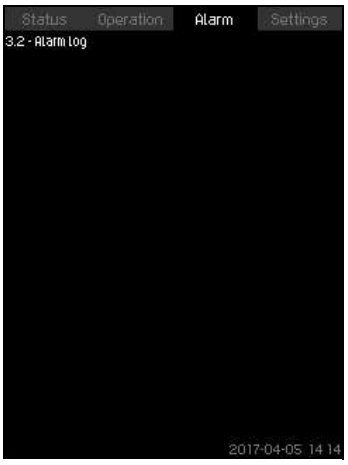


Fig. 41 Alarm log

Description

This display shows warnings and alarms.

For every warning or alarm, the following is shown:

- Whether it is a warning ⚠ or an alarm ⊗.
- Where the fault occurred: System, Pump 1, Pump 2, etc.
- In case of input-related faults, the input is shown.
- The cause of the fault and the alarm code in brackets, such as "Water shortage (214)".
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time are shown as "--...--".

The most recent warning or alarm is shown at the top of the display.

9.6.4 Service contact information (3.3)

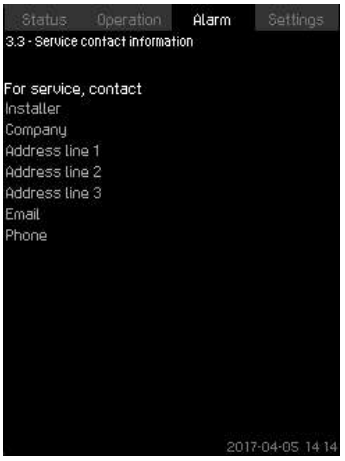


Fig. 42 Service contact information

Description

This display shows the contact information of the installer if entered during commissioning.

9.7 Settings (4)

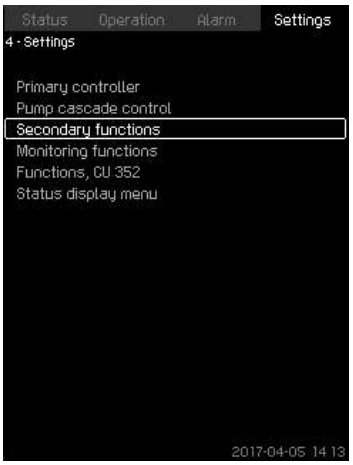


Fig. 43 Settings

In this menu, you can set the following functions:

- Primary controller
  PI controller, Alternative setpoints, External setpoint influence, Primary sensor, Secondary sensor, Clock program, Proportional pressure, S-system configuration, Setpoint ramp.
- Pump cascade control
  Min. time between start/stop, Max. number of starts/hour, Number of standby pumps, Forced pump changeover, Pump test run, Pump stop attempt, Pump start and stop speed, Min. performance, Compensation for pump start-up time.
- Secondary functions
  Stop function, Soft pressure build-up, Digital inputs, Analog inputs, Digital outputs*, Analog outputs, Counter inputs, Emergency run, Min., max. and user-defined duty, Pump curve data, Control source, Fixed inlet pressure, Flow estimation, Reduced operation, Multisensor settings.
- Monitoring functions
  Dry-running protection, Min. pressure, Max. pressure, External fault, Limit 1 exceeded, Limit 2 exceeded, Pumps outside duty range, Pressure relief, Log values, Fault, primary sensor, Non-return valve.
- Functions, CU 352
  Display language, Units, Date and time, Password, Ethernet, GENIbus number Software status, Display 1, Display 2, Display 3.
- The service language, English, can be selected for service purposes. All these functions are usually set correctly when the system is switched on.

9.7.1 Primary controller (4.1)

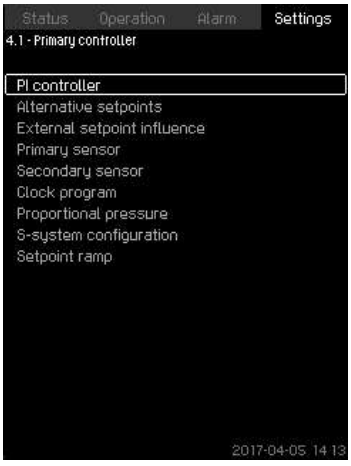


Fig. 44 Primary controller

Description

In this menu, you can set the functions related to the primary controller. It is only necessary to make settings in this menu if the functionality is to be expanded with one of the functions below:

- PI controller
- Alternative setpoints
- External setpoint influence
- Primary sensor
- Secondary sensor
- Clock program
- Proportional pressure
- S-system configuration.

9.7.2 PI controller (4.1.1)

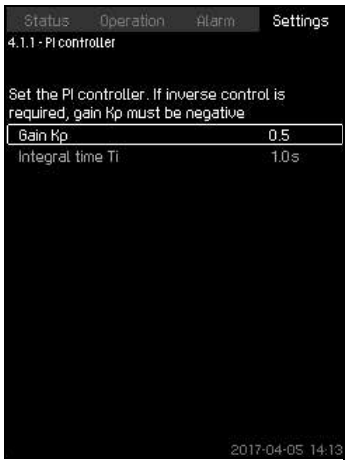


Fig. 45 PI controller

Description

The system includes a standard PI controller which ensures that the pressure is stable and corresponds to the setpoint.

You can adjust the PI controller if a faster or slower reaction to changes of consumption is required.

To obtain a faster reaction, increase Kp and reduce Ti.

To obtain a slower reaction, reduce Kp and increase Ti.

Setting range

- "Gain Kp": -30 to 30.
  Note: For inverse control, set Kp to a negative value.
- "Integral time Ti": 0.1 to 3600 seconds.

Setting via the operating panel

- Settings
- Primary controller
- PI controller.

1. Set "Gain Kp" and "Integral time Ti".
   Note: Usually it is not necessary to adjust Kp.

Factory setting

The setting of Kp and Ti depends on the system and application.

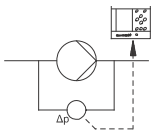
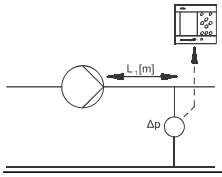
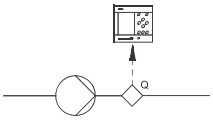
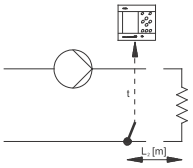
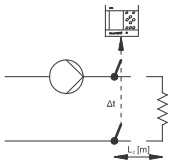
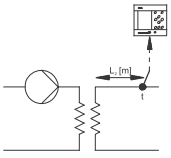
PI controller settings for pressure boosting

If the application has been set to pressure boosting in the startup wizard, the following values of Kp and Ti are set automatically:

- Kp: 0.5
- Ti: 1 second.

PI controller settings for heating and cooling

If another application than pressure boosting has been selected in the startup wizard, the values of Kp and Ti are set automatically according to the table below. As the system does not know the pipe length, the default parameters are set according to the table to a pipe length (L1 or L2) of 16 ft (5 m).

System/application	Kp		Ti [seconds]
	Heating system[1)]	Cooling system[2)]	
	0.5		1
	0.5		L1 < 16 ft(5 m): 1 L1 > 16 ft(5 m): 3 L1 > 33 ft (10 m): 5
	0.5		1
	0.5	-0.5	10 + 5L2
	0.5		10 + 5L2
	0.5	-0.5	30 + 5L2

[1)] Heating systems are systems in which an increase in pump performance will result in a temperature rise at the sensor.

[2)] Cooling systems are systems in which an increase in pump performance will result in a temperature drop at the sensor.

L1: Distance [ft (m)] between pump and sensor.

L2: Distance [ft (m)] between heat exchanger and sensor.

ΔP: Measurement of differential pressure.

Q: Measurement of flow rate.

t: Measurement of temperature.

Δt: Measurement of differential temperature.

9.7.3 Alternative setpoints (4.1.2)

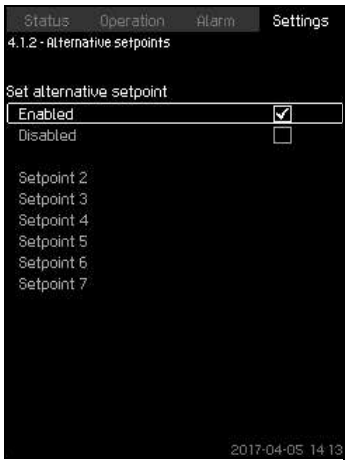


Fig. 46 Alternative setpoints

Description

This function allows you to select up to six setpoints (2 to 7) as alternatives to the primary setpoint (1). The primary setpoint (1) is set in the menu "Operation".

Every alternative setpoint can be addressed manually to a separate digital input (DI). When the contact of the input is closed, the alternative setpoint applies.

If more than one alternative setpoint has been selected, and they are activated at the same time, CU 352 selects the setpoint with the lowest number.

Setting range

- Six setpoints, numbers 2 to 7.

Factory setting

No alternative setpoints have been selected.

9.7.4 Alternative setpoints 2-7 (4.1.2.1 - 4.1.2.7)

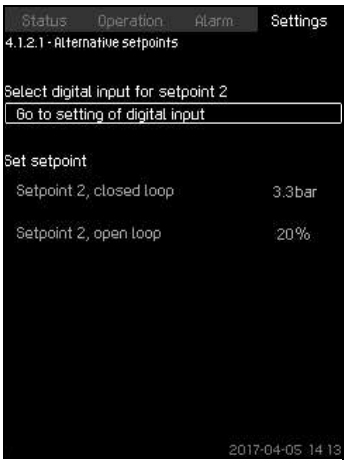


Fig. 47 Alternative setpoints 2-7

For each alternative setpoint, select the digital input to activate the setpoint.

You can set a setpoint for closed loop and for open loop.

Setting via the operating panel

- Settings > Primary controller > Alternative setpoints.

1. Select alternative setpoint.
2. Select: Go to setting of digital input.
   Display *Digital inputs (4.3.7)* appears.
3. Set the input.
4. Press ↩.
5. Select the menu line of the setpoint (closed or open loop).
6. Set the setpoint.
   Set both setpoints if the system is to be controlled both in open and closed loop.

Factory setting

No alternative setpoints have been set.

9.7.5 External setpoint influence (4.1.3)

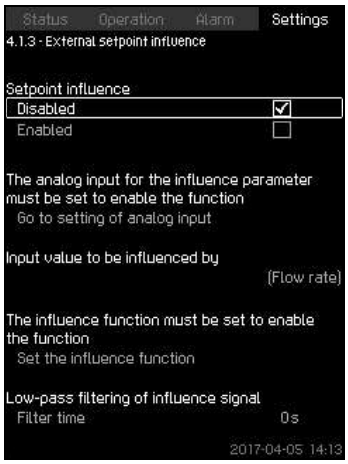


Fig. 48 External setpoint influence

Description

This function allows you to adapt the setpoint by letting measuring parameters influence the setpoint. Typically an analog signal from a flow or temperature transmitter, or a similar transmitter. For an overview of transmitter types and possible positions, see installation and operating instructions for Control MPC.

As an example, the setpoint can be adapted to parameters that can influence the outlet pressure or temperature of the system. The parameters which influence the performance of the system are shown as a percentage from 0 to 100 %. They can only reduce the setpoint, as the influence as a percentage divided with 100 is multiplied with the setpoint:

Actual setpoint (SP) = selected setpoint x influence (1) x influence (2) x etc.

The influence values can be set individually.

A low-pass filter ensures smoothing of the measured value which influences the setpoint. This results in stable setpoint changes.

Setting range

- 0-100 % signal
- Inlet pressure
- Outlet pressure
- External pressure
- Diff. pressure, external
- Diff. pressure, pump
- Flow rate
- Tank level, outlet side
- Tank level, suction side
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Differential temperature.

Setting via the operating panel

- Settings > Primary controller > External setpoint influence > Input value to be influenced by.
  A list of available parameters appears.

1. Select the parameter which is to influence the setpoint.
2. Press ⮌.
3. Set the influence function.
   See section *9.7.6 Setting of influence function (4.1.3.2)*.
4. Set the number of points.
5. Set: External input value (Point 1).
6. Set as a percentage: Reduce setpoint to (Point 1).
7. Repeat steps 4 to 6 for all desired parameters.
8. Press ⮌.
9. Set as seconds: Filter time.
10. Select: Enabled.

Factory setting

The function is disabled.

9.7.6 Setting of influence function (4.1.3.2)

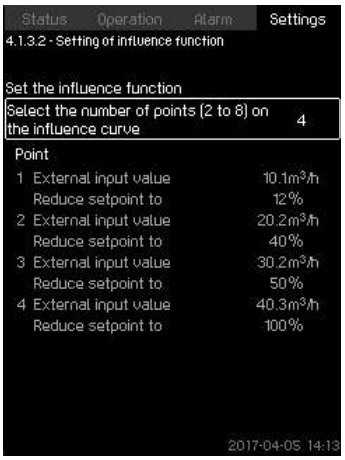


Fig. 49 Setting of influence function

Description

You can select the relation between the measuring parameter which is to influence the setpoint and the desired influence as a percentage.

The relation is set by entering values in a table with maximum eight points by means of the operating panel.

Example:

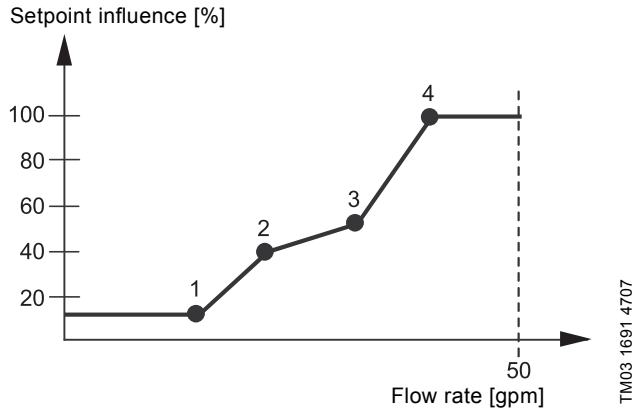


Fig. 50 Relation between setpoint influence and flow rate

The control unit draws straight lines between the points. A horizontal line is drawn from the minimum value of the relevant sensor (0 gpm in the example) to the first point. This is also the case from the last point to the sensor's maximum value (example 50 gpm).

Setting range

Two to eight points can be selected. Each point contains the relation between the value of the parameter which is to influence the setpoint and the influence of the value.

Setting via the operating panel

- Settings > Primary controller > External setpoint influence.

1. Set the influence function.
2. Set the number of points.
3. Set: External input value (Point 1).
4. Set as a percentage: Reduce setpoint to (Point 1).
5. Repeat steps 2 to 4 for all desired parameters.

Factory setting

The function is disabled.

9.7.7 Primary sensor (4.1.4)

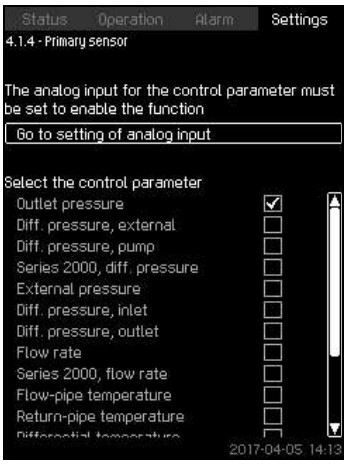


Fig. 51 Primary sensor

Description

You can select the control parameter of the system and set the sensor to measure the value.

Setting range

- Outlet pressure
- Diff. pressure, external
- Diff. pressure, pump
- Series 2000, diff. pressure
- External pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Flow rate
- Series 2000, flow rate
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Return-pipe temp., external
- 0-100 % signal
- Not used.

Setting via the operating panel

- Settings > Primary controller > Primary sensor > Go to setting of analog input.
  Display *Analog inputs (4.3.8)* appears.

1. Select analog input (AI) for the primary sensor and set the parameters.
2. Press ↩.
3. Select control parameter for the primary sensor.

Factory setting

The primary parameter is the outlet pressure. The sensor is connected to AI1 (CU 352). Other primary parameters can be selected in the startup wizard.

9.7.8 Secondary sensor (4.1.5)

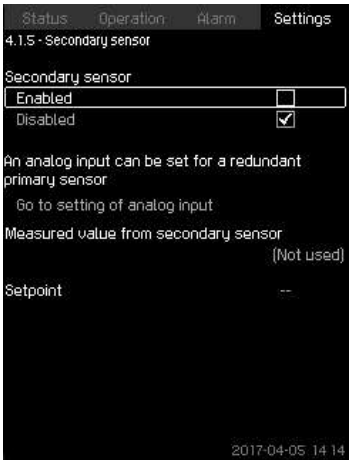


Fig. 52 Secondary sensor

Description

This function is designed for optimizing the constant-pressure control, where there is a high dynamic friction loss. The function enables the possibility of placing a primary sensor on the critical point in the system.

The sensor needs to be hardwired back to the controller, and will act as primary sensor hence utilizing the normal "Setpoint" setting.

The "Secondary sensor" is then the "local" sensor placed on the pump system manifold close to the control cabinet.

In case of a fault on the "Primary sensor", the "Secondary sensor" will automatically take over using its specified "Setpoint". The difference between the setpoint of the "Primary sensor" and the "Secondary sensor" is equal to the total pressure losses in between the two sensors at maximum flow.

Setting range

- Enabled or Disabled function

1. Setting of analog input
2. Setting of "Measured value from secondary sensor"
3. Setting of "Setpoint"

Settings via the operating panel

- Settings > Primary controller > Secondary sensor

1. Enable the function.
2. Define the analog input used for "Secondary sensor".
3. Define "Measured value from secondary sensor".
4. Define "Setpoint" for "Secondary sensor" operation.

9.7.9 Clock program (4.1.6)

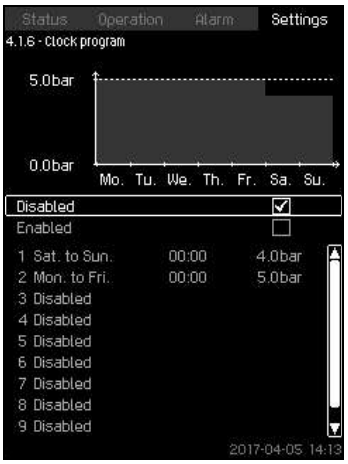


Fig. 53 Clock program

Description

With this function, you can set setpoints and day and time for their activation. You can also set day and time for stop of the system.

If the clock program is disabled, the setpoint of the program will remain active.

Minimum two events are required when activating the clock program: one to start the system and one to stop the system.

Setting range

- Activation and setting of event.

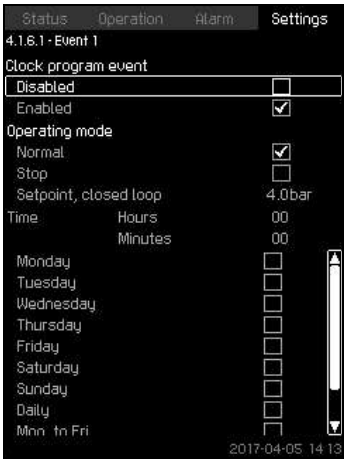


Fig. 54 Event 1

Setting via the operating panel

- Settings > Primary controller > Clock program.

1. Enable the function.
2. Select and enable one of the ten events.
3. Select: Normal or Stop. Skip step 4 if you select "Stop".
4. Set: Setpoint, closed loop.
5. Set: Time, Hours, Minutes.
6. Select the day of week on which the settings are to be activated.
7. Select: Enabled.
8. Repeat steps 2 to 7 if several events are to be enabled.
   Note: Up to ten events can be set.
9. Press ⮌.
10. Select: Enabled.

Factory setting

The function is disabled.

9.7.10 Proportional pressure (4.1.7)

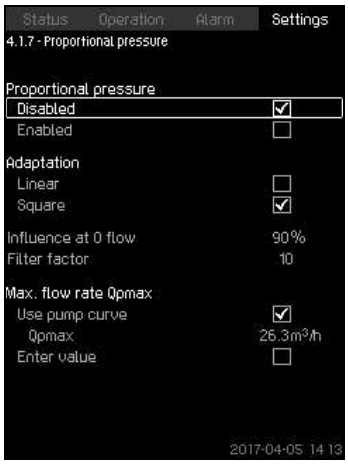


Fig. 55 Proportional pressure

Description

The function can only be enabled in pressure-controlled systems and it automatically adapts the setpoint to the actual flow rate to compensate for flow-dependent dynamic losses. As many systems are designed with extra flow capacity, the estimated maximum flow rate (Qpmax) can be entered manually. In systems with CR pumps, the pump curves can be used to calculate the maximum flow rate at the selected setpoint. Set a filter factor to prevent fluctuation.

The adaptation can be linear or square. See fig. 55.

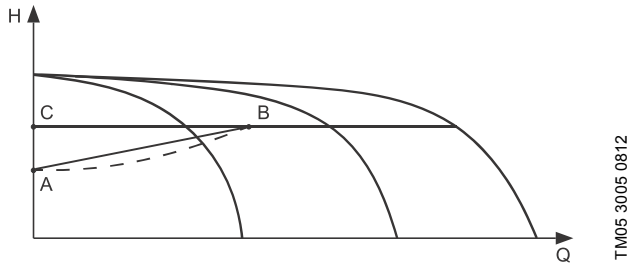


Fig. 56 Proportional pressure

Pos.	Description
A	Pressure at zero flow. Starting point of proportional-pressure control (influence at zero flow = x % of setpoint)
B	Qpmax
C	Setpoint

The function has these purposes:

- to compensate for pressure losses
- to reduce the energy consumption
- to increase the comfort for the user.

Setting range

- Selection of control mode
- Influence at 0 flow
- Estimated flow rate
- Filter factor.

Setting via the operating panel

- Settings > Primary controller > Proportional pressure.

1. Select: Enabled.
2. Select:

- Adaptation
- Linear or Square.

3. Set: Influence at 0 flow.
4. Set: Filter factor.
5. Select: Use pump curve or Enter value.
6. Set "Qpmax" if you select "Enter value".

Factory setting

The function is disabled.

9.7.11 S-system configuration (4.1.8)

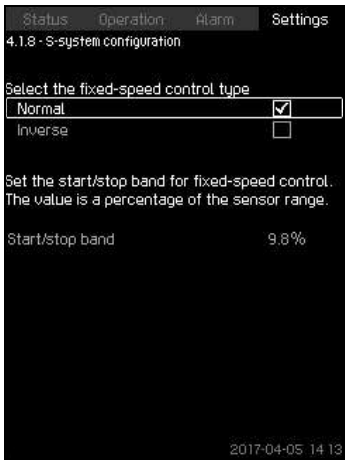


Fig. 57 S-system configuration

Description

The function allows you to invert the control of mains-operated pumps (MPC-S). That is, to set whether pumps are to be started or stopped depending on the actual value.

A start/stop band must be set in order to use this function. See fig. 58.

Normal

A pump is stopped when the value becomes higher than Hset + start/stop band. And a pump is started when the value becomes lower than Hset. See fig. 58.

Inverse

A pump is started when the value becomes higher than Hset + start/stop band. And a pump is stopped when the value becomes lower than Hset. See fig. 58.

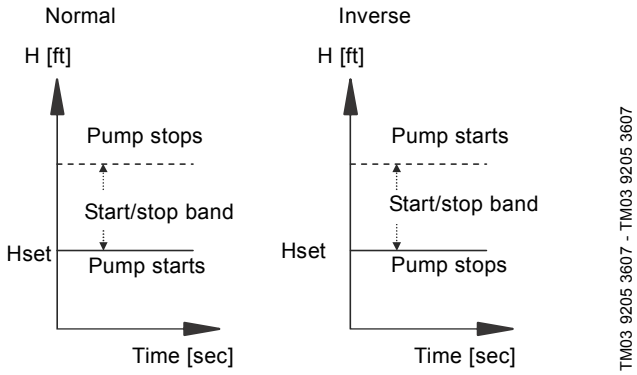


Fig. 58 Normal and inverse control

Setting range

- Selection of configuration (normal or inverse).
- Start/stop band.

Setting via the operating panel

- Settings > Primary controller > S-system configuration.

1. Select: Normal or Inverse.
2. Set: Start/stop band.

Factory setting

Normal.

9.7.12 Setpoint ramp (4.1.9)

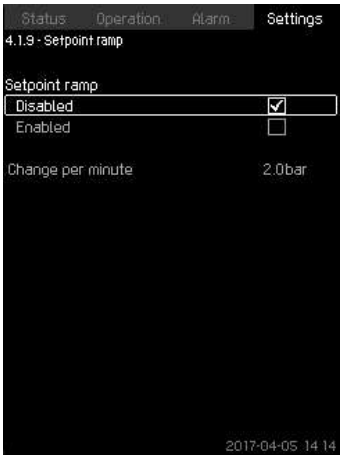


Fig. 59 Setpoint ramp

Description

When this function is enabled, setpoint changes are affected by the setpoint ramp, and the setpoint changes gradually over a period of time.

"Proportional pressure" or "Setpoint influence" are not affected by this function.

Setting range

The function can be enabled and "Change per minute" can be set.

Setting via the operating panel

- Settings > Primary controller > Setpoint ramp.

1. Select: Enabled.
2. Set: Change per minute.

Factory setting

The function is disabled.

9.7.13 Pump cascade control (4.2)

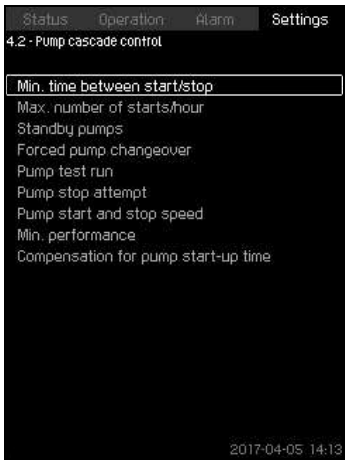


Fig. 60 Pump cascade control

In this menu, you can set the functions connected to pump cascade control.

The following menus can be selected:

- Min. time between start/stop
- Max. number of starts/hour
- Standby pumps
- Forced pump changeover
- Pump test run
- Pilot pump
- Pump stop attempt
- Pump start and stop speed
- Min. performance
- Compensation for pump start-up time.

9.7.14 Min. time between start/stop (4.2.1)

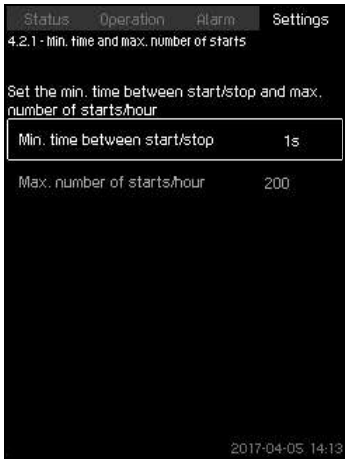


Fig. 61 Min. time between start/stop

Description

This function ensures a delay between the starting and stopping of one pump and the starting and stopping of another pump.

The purpose is to prevent hunting when pumps start and stop continuously.

Setting range

From 1 to 3600 seconds.

Setting via the operating panel

Settings > Pump cascade control > Min. time between start/stop.

Factory setting

The setting is done in the startup wizard and depends on the application.

9.7.15 Max. number of starts/hour (4.2.1)

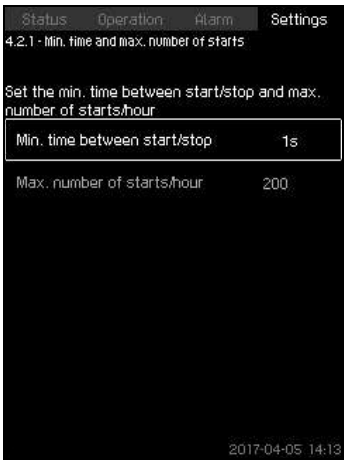


Fig. 62 Max. number of starts/hour

Description

This function limits the number of pump starts and stops per hour for the complete system. It reduces noise emission and improves the comfort of systems with mains-operated pumps.

Each time a pump starts or stops, CU 352 calculates when the next pump is allowed to start/stop in order not to exceed the permissible number of starts per hour.

The function always allows pumps to be started to meet the requirement, but pump stops will be delayed, if needed, in order not to exceed the permissible number of starts per hour.

The time between pump starts must be between the minimum time between start and stop, see section *9.7.14*, and 3600/n, n being the set number of starts per hour.

Setting range

1 to 1000 starts per hour.

Setting via the operating panel

- Settings > Pump cascade control > Max. number of starts/hour.

1. Set:

- Min. time between start/stop.
- Max. number of starts/hour.

Factory setting

MPC-E:	200 starts per hour
Other variants:	100 starts per hour

This function has no influence on *Stop function (4.3.1)*.

9.7.16 Standby pumps (4.2.3)

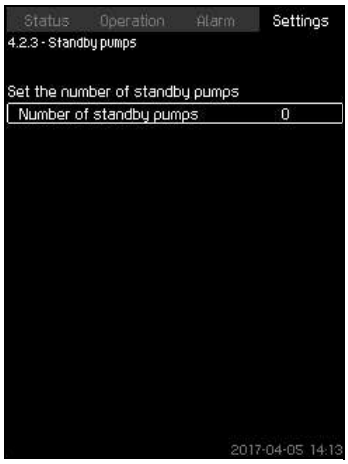


Fig. 63 Standby pumps

Description

This function allows you to limit the maximum performance of the system, by selecting one or more pumps as standby pumps.

If a three-pump system has one standby pump, maximum two pumps are allowed to be in operation at a time.

If one of the two pumps in operation has a fault and has stopped, the standby pump will be started. The performance of the system is thus not reduced.

The status as standby pump alternates between all pumps.

Setting range

The number of possible standby pumps in a system is equal to the total number of pumps in the system minus 1.

Setting via the operating panel

- Settings > Pump cascade control > Standby pumps.
- Set: Set the number of standby pumps.

Factory setting

The number of standby pumps is set to zero. The function is disabled.

9.7.17 Forced pump changeover (4.2.4)

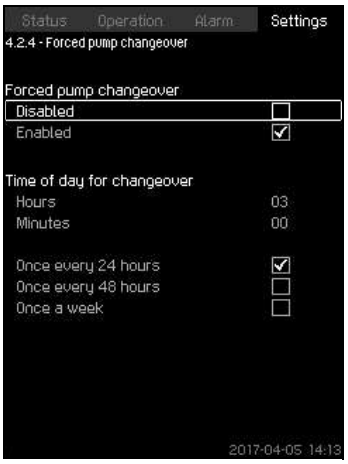


Fig. 64 Forced pump changeover

Description

This function ensures that the pumps run for the same number of operating hours.

In certain applications, the requirement remains constant for long periods and does not require all pumps to run. In such situations, pump changeover does not take place naturally, and forced pump changeover may thus be required.

Once every 24 hours, CU 352 checks if any pump running has a larger number of operating hours than pumps that are stopped. If this is the case, the pump will be stopped and replaced by a pump with a lower number of operating hours.

Setting range

You can enable and disable the function. You can set the hour of the day at which the changeover is to take place.

Setting via the operating panel

- Settings > Pump cascade control > Forced pump changeover.

1. Select: Enabled.
2. Set: Time of day for changeover.
3. Select interval for pump changeover.

Factory setting

The function is enabled. The time is set to 03:00.

9.7.18 Pump test run (4.2.5)

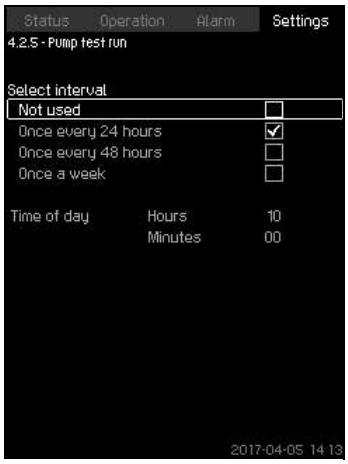


Fig. 65 Pump test run

Description

This function is primarily used in situations where the forced pump changeover is disabled, and/or if the system is set to operating mode "Stop", for instance in a period when the system is not needed. In such situations, it is important to test the pumps regularly.

Advantages of this function:

- Pumps do not seize up during a long standstill due to deposits from the pumped liquid.
- The pumped liquid does not decay in the pump.
- Trapped air is removed from the pump.

The pumps start automatically one by one and run for five seconds.

Pumps in operating mode "Manual" are not included in the test run. If there is an alarm, the test run will not be carried out.

Setting range

- Time of day
- Day of week
- Include pilot pump.

Setting via the operating panel

- Settings > Pump cascade control > Pump test run.

1. Select interval.
2. Set:

- Time of day
- Minutes.

3. Select the day of week if you select "Once a week".
4. If the system is configured with a pilot or a backup pump, select "Include pilot pump".

Factory setting

The function is disabled.

9.7.19 Pump stop attempt (4.2.7)

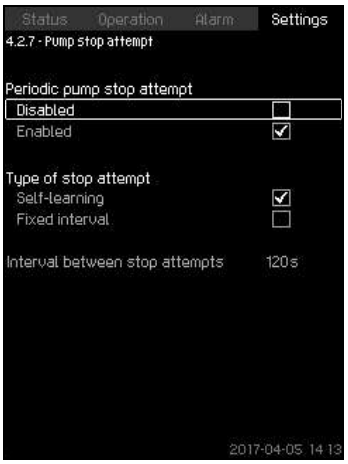


Fig. 66 Pump stop attempt

Description

The function allows you to set automatic stop attempts of a pump when several pumps are running. It ensures that the optimum number of pumps is always running, in terms of energy consumption. See section *9.7.20 Pump start and stop speed (4.2.8)*. At the same time, the purpose is to avoid disturbances in connection with automatic stop of pumps.

Stop attempts can either take place with a fixed interval set under "Interval between stop attempts" or by self-learning. If self-learning is selected, the interval between stop attempts will be increased if repeated attempts to stop the pump fail.

Setting via the operating panel

- Settings > Pump cascade control > Pump stop attempt.

1. Select: Self-learning or Fixed interval.
2. Set "Interval between stop attempts" if you select "Fixed interval".
3. Select: Enabled.

Factory setting

The function is enabled, and "Self-learning" is selected.

9.7.20 Pump start and stop speed (4.2.8)

Description

The function controls the starting and stopping of pumps. There are two options:

1. Use calculated speed
   This function ensures that the optimum number of pumps is always running at a desired duty point, in terms of energy consumption. CU 352 calculates the required number of pumps and their speed. This requires that the differential pressure of the pump is measured by a differential-pressure sensor or separate pressure sensors on the inlet and outlet side. If calculated speed has been selected, CU 352 ignores the percentages set.
2. Use fixed speed
   The pumps are started and stopped at speeds set by the user.

1. Use calculated speed

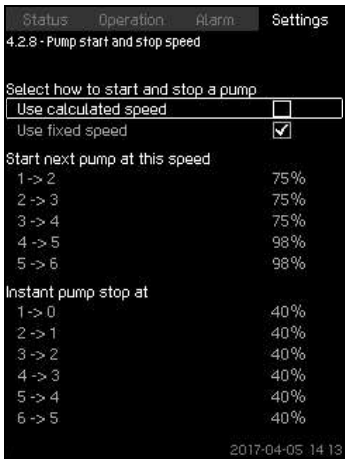


Fig. 67 Use calculated speed

Setting via the operating panel

- Settings > Pump cascade control > Pump start and stop speed > Use calculated speed.

2. Use fixed speed

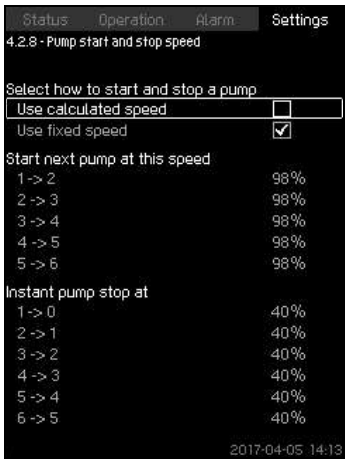


Fig. 68 Use fixed speed

Setting via the operating panel

- Settings > Pump cascade control > Pump start and stop speed.
- Select: Use fixed speed.
- Set: Start next pump at this speed > 1 -> 2.

1. Set the speed as percentage.
2. Set the other pumps in the same way.
3. Select: Instant pump stop at > 1 -> 0.
4. Set the speed as percentage.
5. Set the other pumps in the same way.

Factory setting

The function is set to calculated speed.

9.7.21 Min. performance (4.2.9)

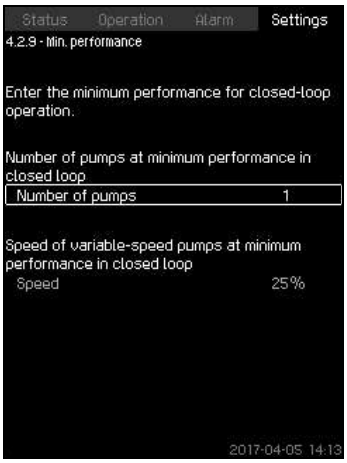


Fig. 69 Min. performance

Description

This function ensures circulation in a system. Note that the stop function, if enabled, can influence this function. See section *9.7.24 Stop function (4.3.1)*. Examples:

- If zero pumps have been selected, the stop function can stop the pump if there is no or a very small consumption.
- If pumps have been selected, the stop function will not be active.

Setting via the operating panel

- Settings > Pump cascade control > Min. performance.

1. Set:

- Number of pumps
- Speed.

Factory setting

The number of pumps is set to zero. The speed in closed loop is set to 25 %.

9.7.22 Compensation for pump start-up time (4.2.10)

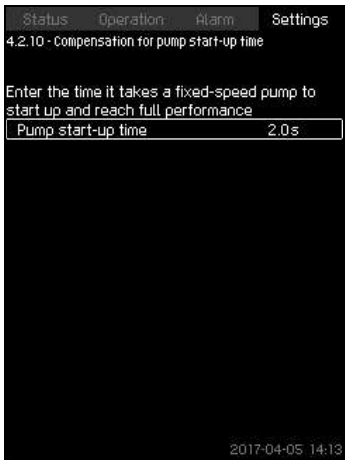


Fig. 70 Compensation for pump start-up time

Description

The function is used for MPC-F systems only.

The purpose is to avoid disturbances when a mains-operated pump with fixed speed is started. The function compensates for the time it takes a mains-operated pump to reach its full performance after start. The startup time of the mains-operated pump must be known.

Setting via the operating panel

- Settings > Pump cascade control > Compensation for pump start-up time.
- Set: Pump start-up time

Factory setting

The startup time is set to zero seconds.

9.7.23 Secondary functions (4.3)

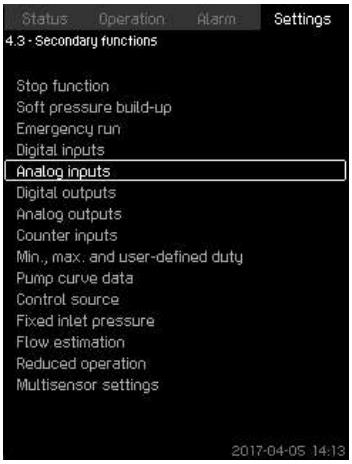


Fig. 71 Secondary functions

Description

In this display, you can set functions that are secondary in relation to the normal operation of the system. Secondary functions are functions that offer additional functionality.

The display allows you to open these specific displays:

- *Stop function (4.3.1)*
- *Soft pressure build-up (4.3.3)*
- *Digital inputs (4.3.7)*
- *Analog inputs (4.3.8)*
- *Digital outputs (4.3.9)*
- *Analog outputs (4.3.10)*
- *Counter inputs (4.3.11)*
- *Emergency run (4.3.5)*
- *Min., max. and user-defined duty (4.3.14)*
- *Pump curve data (4.3.19)*
- *Flow estimation (4.3.23)*
- *Control source (4.3.20)*
- *Fixed inlet pressure (4.3.22)*
- *Flow estimation (4.3.23)*
- *Reduced operation (4.3.24)*
- *Multisensor settings (4.3.25)*

9.7.24 Stop function (4.3.1)

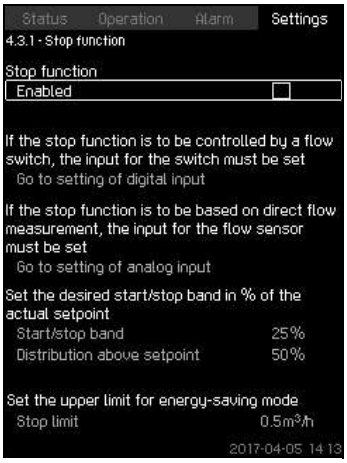


Fig. 72 Stop function

Description

This function is typically used in constant-pressure applications and allows you to stop the last pump if there is no or a very small consumption.

Purpose of the function:

- to save energy
- to prevent heating of shaft seal faces due to increased mechanical friction as a result of reduced cooling by the pumped liquid
- to prevent heating of the pumped liquid.

The description of the stop function applies to all pump systems with variable-speed pumps. MPC-S systems will have on/off control of all pumps as described in section *7. Overview of control variants*.

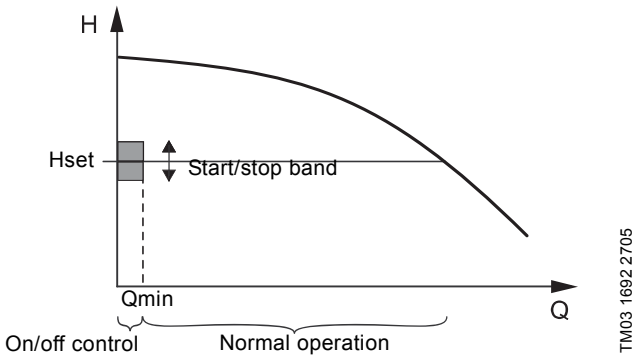


Fig. 73 Start/stop band

When the stop function is enabled, the operation is continuously monitored to detect a low flow rate. When CU 352 detects no or a low flow rate (Q < Qmin), it changes from constant-pressure operation to on/off control of the last pump in operation.

Before stopping, the pump increases the pressure to a value corresponding to Hset plus (distribution above setpoint / 100) x start/stop band. The pump is restarted when the pressure is Hset minus (100-distribution above setpoint) / 100 x start/stop band. See fig. 74. The start/stop band can be distributed around the setpoint.

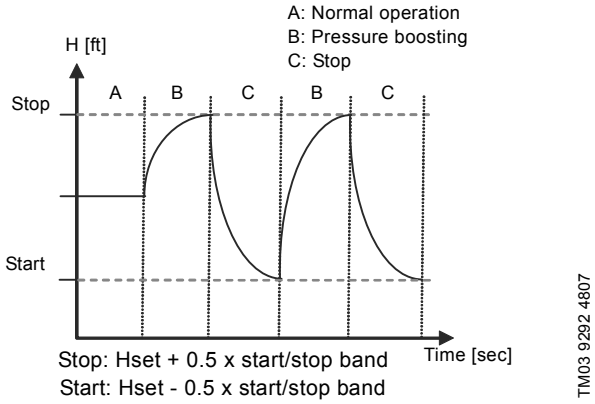


Fig. 74 On/off operation

The flow rate is estimated by CU 352 when the pump is in the stop period. As long as the flow rate is lower than Qmin, the pump will run on/off. If the flow rate is increased to above Qmin, the pump returns to normal operation, Hset. Hset is equal to the actual setpoint. See section *9.4.4 Setpoint (1.2.2)*.

Detection of low flow rate

Low flow rate can be detected in two ways:

- direct flow measurement with a flowmeter or flow switch
- estimation of flow rate by measurement of pressure and speed.

If the pump system is not connected to a flowmeter or flow switch, the stop function will use the estimating function.

If the detection of low flow rate is based on flow estimation, a diaphragm tank of a certain size and with a certain precharge pressure is required.

Selection of diaphragm tank size

Pump type	Recommended diaphragm tank size [gal (L)]		
	-E	-F	-S
CRI(E) 3	4.4 (17)	4.4 (17)	20 (76)
CRI(E) 5	4.4 (17)	4.4 (17)	34 (129)
CRI(E) 10	10.2 (39)	10.2 (39)	62 (235)
CRI(E) 15	34 (129)	34 (129)	211 (799)
CRI(E) 20	34 (129)	34 (129)	211 (799)
CR(E) 32	44 (167)	44 (167)	317 (1200)
CR(E) 45	86 (326)	86 (326)	528 (1999)
CR(E) 64	132 (500)	132 (500)	1056 (3997)
CR(E) 950	132 (500)	132 (500)	1056 (3997)
CR(E) 125	211 (799)	211 (799)	(2) x 1056 (3997)
CR(E) 155	211 (799)	211 (799)	(2) x 1056 (3997)

We recommend that the Hydro MPC CME pump sets are equipped with a diaphragm tank due to the stop function. Hydro MPC CME systems with the following pump types on system have the corresponding recommended diaphragm tank size:

Recommended diaphragm tank size [gal (L)]	
Pump type	Tank size
CME 3	4.4 (17)
CME 5	4.4 (17)
CME 10	10.3 (39)
CME 15	34 (129)
CME 25	34 (129)

Precharge pressure

Hydro MPC-E and -F: 0.7 x setpoint.

Hydro MPC-S: 0.9 x setpoint.

During each flow estimation (every 2 minutes), the estimating function will disturb the outlet pressure by ± 10 % of the setpoint. If this disturbance is not acceptable, the stop function must be based on direct flow measurement with a flowmeter or flow switch.

The minimum flow rate can be set, that is the flow rate at which the pump system changes to on/off control of the last pump in operation.

If both a flowmeter and a flow switch are connected, the changeover to on/off control will be determined by the unit first indicating low flow rate.

Setting range

Start/stop band:	5-30 %
Minimum flow rate:	2-50 % of the rated flow rate (Qnom) of one of the pumps. (It can only be set if direct flow measurement by means of flowmeter has been selected.)
Distribution above setpoint:	0-100 %.

Setting via the operating panel

System without flow switch or flowmeter

- Settings > Secondary functions > Stop function.
- Select: Enabled.

1. Set: Start/stop band.
2. Select: Go to setting of flow stop parameters. The display below appears.

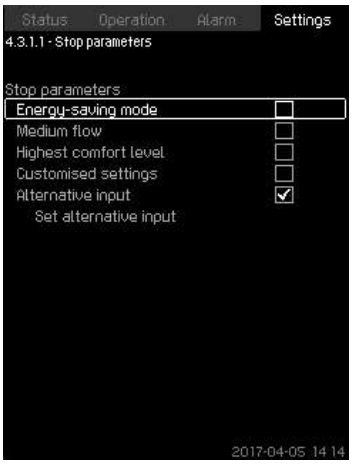


Fig. 75 Stop parameters

3. Select one of the stop parameters. If you select "Customised settings", you must set the parameters shown in fig. 76. See the examples below.

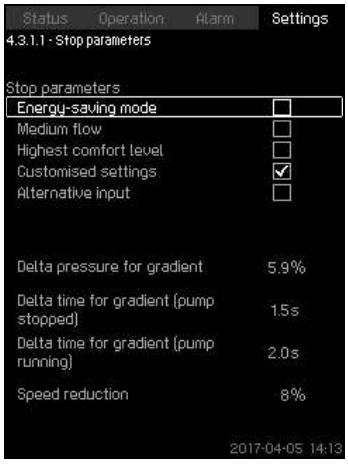


Fig. 76 Customised settings

Rule of thumb: Speed reduction = 2 x delta pressure for gradient.

Example 1: Increasing the stop limit, Qmin (high flow limit)

- Increase "Delta pressure for gradient".
- Reduce "Delta time for gradient (pump stopped)".
- Reduce "Delta time for gradient (pump running)".
- Increase "Speed reduction".

Example of increased stop limit	
Parameter	**Value**
Delta pressure for gradient	6 %
Delta time for gradient (pump stopped)	1.5 seconds
Delta time for gradient (pump running)	2.0 seconds
Speed reduction	10 %

Example 2: Reducing the stop limit, Qmin (low flow limit)

- Reduce "Delta pressure for gradient".
- Increase "Delta time for gradient (pump stopped)".
- Increase "Delta time for gradient (pump running)".
- Reduce "Speed reduction".

Example of reduced flow limit	
Parameter	**Value**
Delta pressure for gradient	3 %
Delta time for gradient (pump stopped)	15.0 seconds
Delta time for gradient (pump running)	25.0 seconds
Speed reduction	6 %

The stop limit depends on the tank size.

Alternative input

If you select "Alternative input", the controller calculates the stop parameters based on the following inputs:

- system set-point
- total tank volume
- precharge pressure
- desired stop flow.

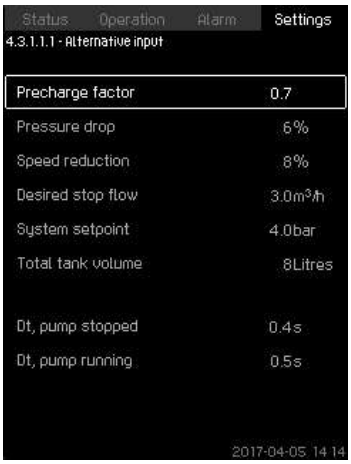


Fig. 77 Alternative input

System with flow switch

Make the following additional settings:

1. Select: Go to setting of digital input.
   Display *Digital inputs (4.3.7)* appears.
2. Select the digital input where the flow switch is connected.
3. Select: Flow switch.
4. Press ↩.

An open contact indicates low flow.

System with flowmeter

Make the following additional settings:

1. Select: Go to setting of analog input.
   Display *Analog inputs (4.3.8)* appears.
2. Select the analog input where the flowmeter is connected.
3. Select: Flow rate.
4. Press ↩ x 2.
5. Set: Stop limit.

As standard, there is a 10-seconds detection hysteresis. It can be adjusted with PC-Tool E-products.

Factory setting

The function is enabled in pressure-boosting applications with the settings in the table.

Start/stop band:	25 %
Min. flow rate:	30 % of the rated flow rate of one pump
Distribution above setpoint:	50 %

The function is disabled in all other applications.

9.7.25 Soft pressure build-up (4.3.3)

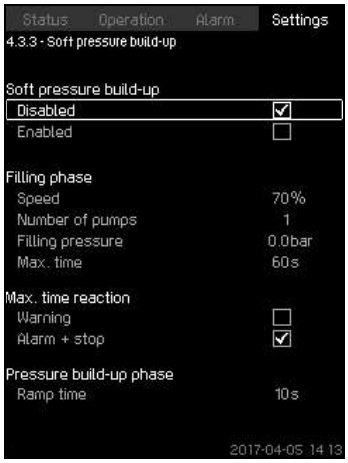


Fig. 78 Soft pressure build-up

Description

This function is typically used in pressure-boosting applications and ensures a smooth startup of systems with for instance empty pipes.

Startup takes place in two phases. See fig. 79.

1. Filling phase
   The pipes are slowly filled with water. When the pressure sensor of the system detects that the pipes have been filled, phase two begins.
2. Pressure build-up phase
   The system pressure is increased until the setpoint is reached. The pressure buildup takes place over a ramp time. If the setpoint is not reached within a given time, a warning or an alarm can be given, and the pumps can be stopped at the same time.

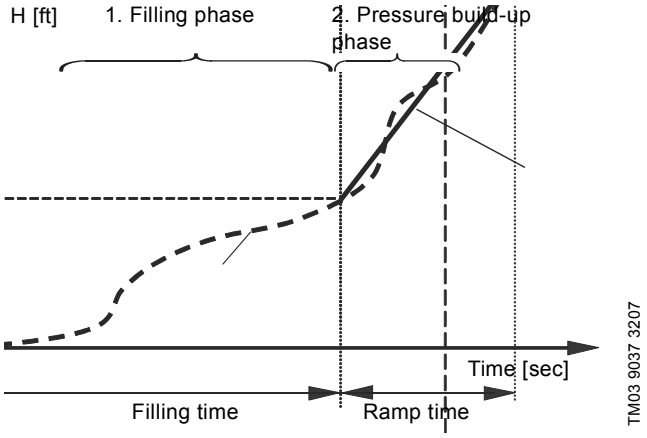


Fig. 79 Filling and pressure buildup phases

Setting range

- Pump speed
- Number of pumps
- Filling pressure
- maximum filling time
- Warning or Alarm + stop
- "Ramp time" for "Pressure build-up phase".

Setting via the operating panel

- Settings > Secondary functions > Stop function > Soft pressure build-up.

1. Select and set:
- Speed
- Number of pumps
- Filling pressure
- Max. time.

2. Select: Warning or Alarm + stop.
3. Set: Ramp time.
4. Select: Enabled.

Factory setting

The function is disabled.

9.7.26 Emergency run (4.3.5)

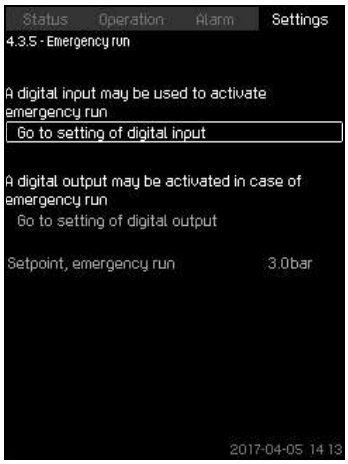


Fig. 80 Emergency run

Description

This function is used in boosting applications. When this function has been enabled, the pumps will keep running regardless of warnings or alarms. The pumps will run according to a setpoint set specifically for this function.

In case of sensor fault, both main and standby pumps will run at 100 % speed.

Setting range

- Setting of digital input (*9.7.27 Digital inputs (4.3.7)*).
- Setting of digital output (*9.7.32 Digital outputs (4.3.9)*).
- Setting of setpoint for emergency run.

Setting via the operating panel

- Settings > Secondary functions > Emergency run > Go to setting of digital input.

1. Select digital input.
2. Select: Emergency run.
3. Press ↩ x 2.
4. Select: Go to setting of digital output.
5. Select digital output.
6. Select: Emergency run.
7. Press ↩ x 2.
8. Set: Setpoint, emergency run.

When you have set this function described above, you can also enable it via the display *System operating mode (2.1.1)*.

9.7.27 Digital inputs (4.3.7)

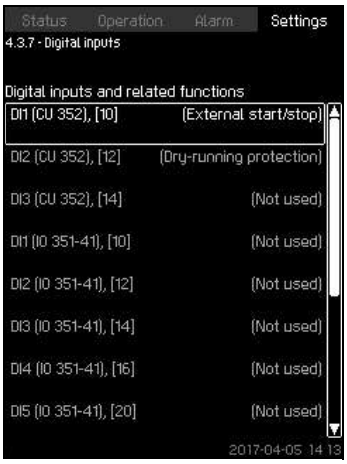


Fig. 81 Digital inputs

Description

In this menu, you can set the digital inputs of CU 352. Each input, except DI1, can be activated and related to a certain function.

As standard, the system has three digital inputs. If the system incorporates an IO 351B module (option), the number of digital inputs is 12.

All digital inputs are shown so that their physical position in the system can be identified.

Example

DI1 (IO 351-41), [10]:

DI1:	Digital input No 1
(IO 351-41):	IO 351, GENIbus number 41
[10]:	Terminal No 10

For further information on the connection of various digital inputs, see the wiring diagram supplied with the control cabinet.

Setting range

DI1 (CU 352) cannot be selected.

Setting via the operating panel

- Settings > Secondary functions > Digital inputs.

9.7.28 Functions of digital inputs (4.3.7.1)

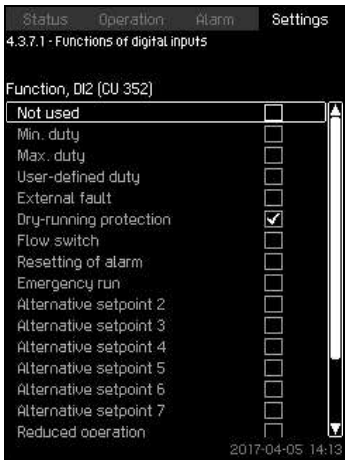


Fig. 82 Functions of digital inputs

Description

A function can be related to the digital inputs.

Setting range

You can select one function in each display:

Function	Contact activated
Not used	
Min. duty	= Operating mode "Min."
Max. duty	= Operating mode "Max."
User-defined duty	= Operating mode "User-defined"
External fault	= External fault
Dry-running protection	= Water shortage
Flow switch	= Flow
Resetting of alarm	= Alarms are reset
Emergency run	= Operating mode "Emergency run"
Fault, pilot pump	= Fault
Alternative setpoint 2-7	= The setpoint is selected
Reduced operation	= Activation of "Reduced operation"
Stop pump 1-6 Stop pilot pump	= Forces the pump to stop

In the display, you can only select pumps defined in the system.

See the relevant sections for further information about the functions.

Generally, a closed contact activates the function selected.

Setting via the operating panel

- Settings > Secondary functions > Stop function > Go to setting of digital input.

Factory setting

Digital input	Function
DI1 (CU 352) [10]	External start/stop. Open contact = stop. **Note:** Input No 1 cannot be changed.
DI2 (CU 352) [12]	Monitoring of water shortage (dry-running protection). Open contact = water shortage (if the system is supplied with this option).

Monitoring of water shortage requires a pressure or level switch connected to the system.

9.7.29 Analog inputs (4.3.8)

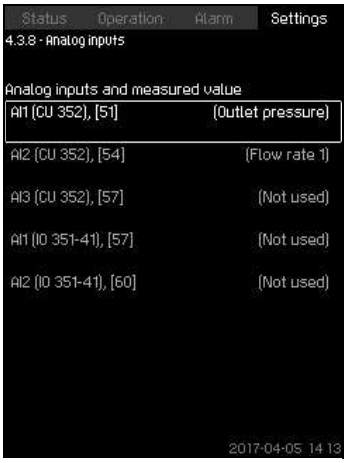


Fig. 83 Analog inputs

Description

Each analog input can be activated and related to a certain function.

As standard, the system has three analog inputs. If the system incorporates an IO 351B module (option), the number of analog inputs is 5.

All analog inputs are shown so that their physical position in the system can be identified. A redundant primary sensor can be fitted as backup for the primary sensor in order to increase reliability and prevent stop of operation.

If two sensors are to be redundant, each must have a separate analog input.

Example

AI1 (CU 352) [51]:

AI1:	Analog input No 1
(CU 352):	CU 352
[51]:	Terminal No 51

Setting via the operating panel

- Settings > Secondary functions > Stop function > Go to setting of analog input.

9.7.30 Analog inputs (4.3.8.1 to 4.3.8.7)

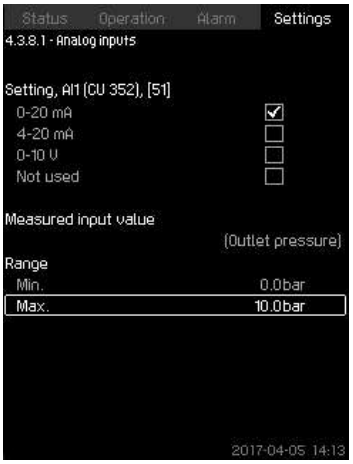


Fig. 84 Analog inputs

Description

In this menu, you can set "Analog inputs". Each display is divided into three parts:

- Setting of input signal, for instance 4-20 mA
- "Measured input value", for instance "Outlet pressure"
- Measuring range of the sensor/signal transmitter, for instance 0-232 psi (0-16 bar).

Setting range

You can set the following parameters in each display:

- Not used
- Range of input signal, 0-20 mA, 4-20 mA, 0-10 V
- Measured input value
- Sensor range.

Setting via the operating panel

- Settings > Secondary functions > Stop function > Go to setting of analog input.

If an analog input is deactivated, the display only shows the setting of the analog input.

If the input is activated, "Measured input value" is shown. This makes it possible to relate a function to the analog input in another display. When the analog input has been related to a function, CU 352 will return to the display for setting of analog inputs.

Factory setting

Pressure boosting	
Analog input	**Function**
AI1 (CU 352) [51]	Outlet pressure

Heating and cooling	
Analog input	**Function**
AI1 (CU 352) [51]	These are selected in the startup wizard

9.7.31 Analog inputs and measured value (4.3.8.1.1 - 4.3.8.7.1)

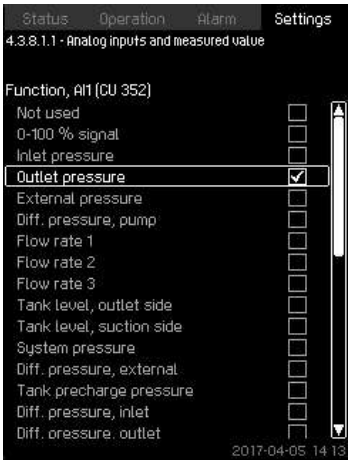


Fig. 85 Analog inputs and measured value

Description

A function can be related to the individual analog inputs.

Setting range

You can select one function per analog input. For further details, see the installation and operating instructions for Control MPC.

- Not used
- 0-100 % signal
- Inlet pressure
- Outlet pressure
- External pressure
- Diff. pressure, pump
- Flow rate 1-3
- Tank level, outlet side
- Tank level, suction side
- System pressure
- Diff. pressure, external
- Tank precharge pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Power, pump 1-6
- Power, VFD
- Multisensor 1-6.

Setting via the operating panel

If more flow rates are used, the flow rate measured and shown is the sum of defined flow rates.

- Settings > Secondary functions > Go to setting of analog input.

1. Select analog input.
2. Select: Measured input value. Display 4.3.8.1.1 appears.
3. Select input.
4. Press ↩.
5. Set the minimum and maximum sensor value.

9.7.32 Digital outputs (4.3.9)

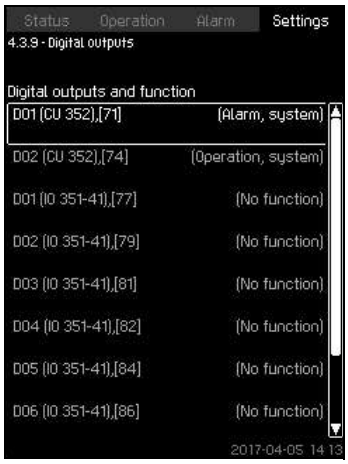


Fig. 86 Digital outputs

Description

Each digital output can be activated and related to a certain function.

As standard, the system has two digital outputs.

If the system incorporates an IO 351B module (option), the number of digital outputs is 9.

All digital outputs are shown so that their physical position in the system can be identified.

Example

DO1 (IO 351-41) [71]:

DO1	Digital output No 1
(IO 351-41)	IO 351B, GENIbus number 41
[71]	Terminal No 71

For further information on the connection of various digital outputs, see the wiring diagram supplied with CU 352.

9.7.33 Function of digital outputs (4.3.9.1 - 4.3.9.16)

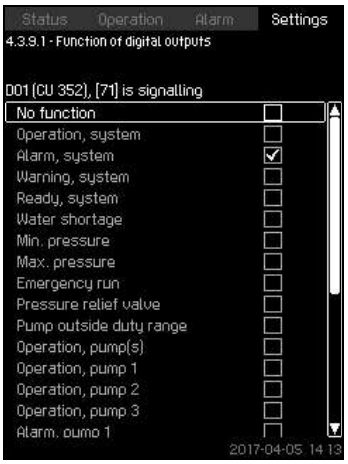


Fig. 87 Function of digital outputs

Description

A function can be related to the individual outputs.

Setting range

You can select one function in each display:

- No function
- Operation, system
- Alarm, system
- Warning, system
- Ready, system
- Water shortage
- Min. pressure
- Max. pressure
- Emergency run
- Operation, pilot pump
- Pressure relief valve
- Pump outside duty range
- Operation, pump(s)
- Operation, pump 1-6
- Alarm, pump 1
- Alarm, limit 1 exceeded
- Warning, limit 1 exceeded
- Alarm, limit 2 exceeded
- Warning, limit 2 exceeded
- Reduced operation.

Setting via the operating panel

- Settings > Secondary functions > Stop function > Go to setting of digital input.

Factory setting

Digital output	Function
DO1 (CU 352) [71]	Alarm, system
DO2 (CU 352) [74]	Operation, system

9.7.34 Analog outputs (4.3.10)

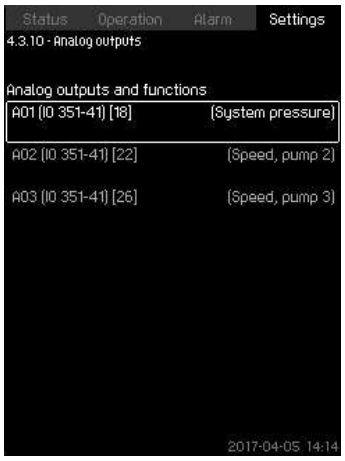


Fig. 88 Analog outputs

This display only appears if an IO 351B module is installed.

Description

CU 352 does not have analog outputs as standard, but the system can be fitted with an IO 351B module with three analog outputs.

Setting via the operating panel

- Settings > Secondary functions > Analog outputs.

9.7.35 Output signal (4.3.10.1 - 4.3.10.3)

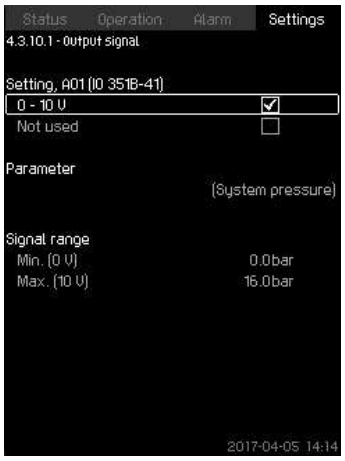


Fig. 89 Output signal

Description

You can select the parameters below.

Setting range

- 0-100 % signal
- Flow rate 1-6
- Inlet pressure
- Outlet pressure
- External pressure
- Diff. pressure, pump
- Tank level, outlet side
- Tank level, suction side
- System pressure
- Diff. pressure, external
- Tank precharge pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- System power
- Power, pump 1-6
- Power, pilot pump
- Power, VFD
- Speed, pump 1-6
- Speed, pilot pump
- Current, pump 1-6
- Current, pilot pump
- Specific energy

Setting via the operating panel

- Settings > Secondary functions > Go to setting of analog input.

1. Select analog output and range.
2. Select: Parameter.
   Display 4.3.10.2 appears.
3. Select output.
4. Press ↩.
5. Set: Signal range.

9.7.36 Counter inputs (4.3.11)

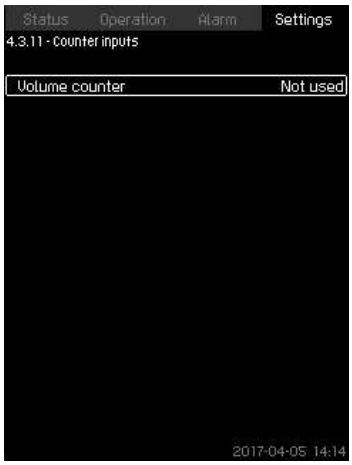


Fig. 90 Counter inputs

Description

You can set CU 352 to accumulate a pumped volume from a digital water meter.

Setting via the operating panel

1. Select digital input for volume counter
2. Define unit (unit of volume per digital input pulse).
3. Define scaling of pulse counts.

This menu only appears if an IO351B module is connected to CU 352.

9.7.37 Min., max. and user-defined duty (4.3.14)

Fig. 91 Min., max. and user-defined duty

Description

This function allows you to let the pumps run in open loop at a set performance.

Setting range

CU 352 allows you to change between three operating modes:

1. *Min. duty (4.3.14.1)*.
2. *Max. duty (4.3.14.2)*.
3. *User-defined duty (4.3.14.3)*.

For each of these operating modes, you can set the number of operating pumps and the pump performance (speed).

9.7.38 Min. duty (4.3.14.1)

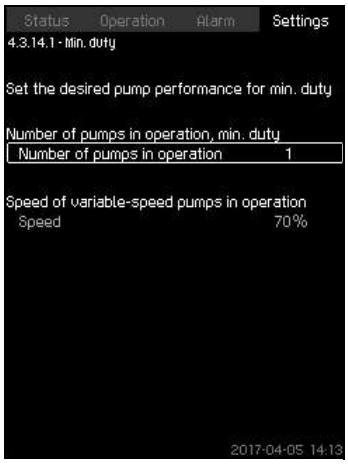


Fig. 92 Min. duty

Description

In all systems, apart from MPC-S systems, minimum duty is only possible for variable-speed pumps. In MPC-S systems, you can only set the number of pumps running at 100 % speed.

Setting range

- Number of pumps in operation.
- Speed as percentage (25 to 100 %) for variable-speed pumps.

Setting via the operating panel

- Settings > Secondary functions > Min., max. and user-defined duty > Min. duty.

Select and set:

- Number of pumps in operation, min. duty.
- Speed.

Factory setting

Number of pumps in operation during min. duty:	1
Speed as percentage for variable-speed pumps:	70

9.7.39 Max. duty (4.3.14.2)

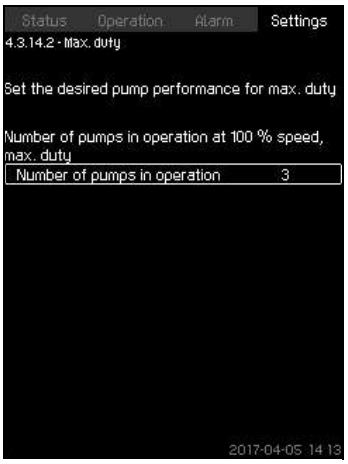


Fig. 93 Max. duty

Description

The function allows you to set a number of pumps to run at maximum performance when the function is enabled.

Setting range

You can set the number of pumps to run in the operating mode "Max.". All pumps run at 100 % speed.

Setting via the operating panel

- Settings > Secondary functions > Min., max. and user-defined duty > Max. duty.

Select and set:

- Number of pumps in operation at 100 % speed, max. duty.

Factory setting

Number of pumps in operation during max. duty:	All pumps (except standby pumps)

9.7.40 User-defined duty (4.3.14.3)

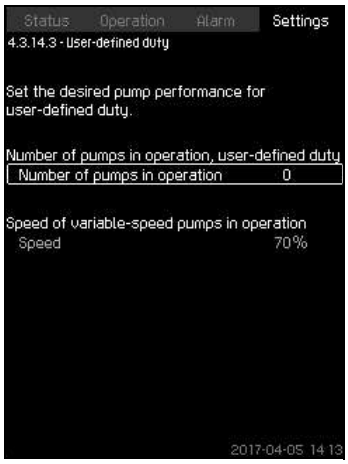


Fig. 94 User-defined duty

Description

You can set a user-defined performance, typically a performance between minimum and maximum duty.

The function allows you to set a pump performance by selecting the number of pumps to run and the speed of variable-speed pumps.

This function primarily selects the variable-speed pumps. If the number of selected pumps exceeds the number of variable-speed pumps, mains-operated pumps are started too.

Setting range

- Number of pumps in operation.
- Speed as percentage for variable-speed pumps.
  Note: In systems with only variable-speed pumps, the speed can be set between 25 and 100 %; in systems with both variable-speed pumps and mains-operated pumps the speed can be set between 70 and 100 %.

Setting via the operating panel

- Settings > Secondary functions > Min., max. and user-defined duty > User-defined duty.

Select and set:

- Number of pumps in operation, user-defined duty.
- Speed.

Factory setting

The function is disabled as the following has been set:

Number of pumps in operation during user-defined duty:	0

9.7.41 Pump curve data (4.3.19)

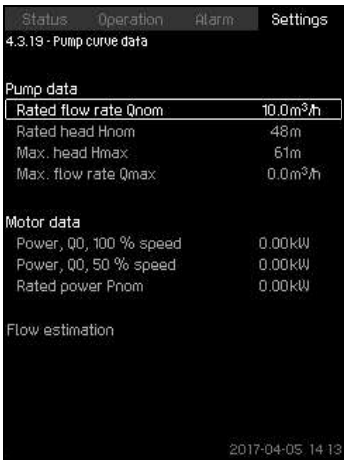


Fig. 95 Pump curve data

Description

CU 352 has a number of functions using these pump data:

- Rated flow rate Qnom [gpm]
- Rated head Hnom [ft]
- Max. head Hmax [ft]
- Max. flow rate Qmax [gpm]
- Power, Q0, 100 % speed [kW]
- Power, Q0, 50 % speed [kW]
- Rated power Pnom [kW]

Grundfos can supply hydraulic data for CR, CRI, CRE and CRIE pumps where GSC files can be downloaded to CU 352.

All other pump types require manual entering of hydraulic pump data.

Enter the electrical data, "Power, Q0, 100 % speed" and "Power, Q0, 50 % speed" manually for all pump types, including CR, CRI, CRE and CRIE.

For Grundfos E-pumps, enter the data of input power (P1).

The data are read by means of the pump performance curves which can be found in Grundfos Product Center on Grundfos' homepage, www.grundfos.com. See the examples in figures 96 to 99.

If Grundfos Product Center is not accessible, try to bring a pump into the three duty points:

- Power, Q0, 100 % speed
- Power, Q0, 50 % speed
- Rated power Pnom.

Read the power values in displays 1.3 to 1.8, depending on the pump. See section *9.4.10 Pump 1-6, Pilot pump (1.3 - 1.10)*.

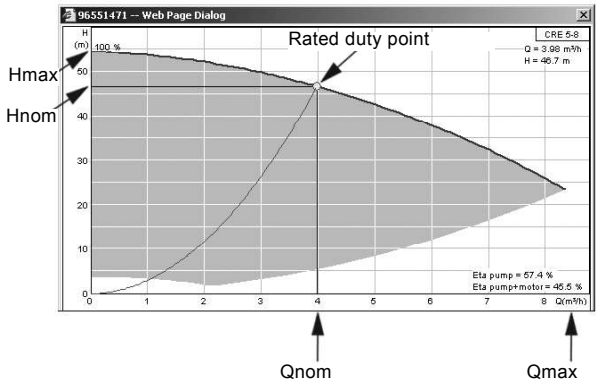


Fig. 96 Reading of Qnom, Hnom, Hmax and Qmax (Grundfos Product Center)

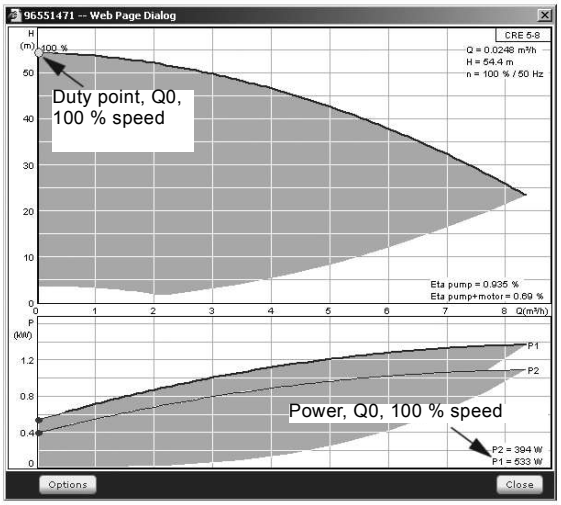


Fig. 97 Reading of power, Q0, 100 % speed (Grundfos Product Center)

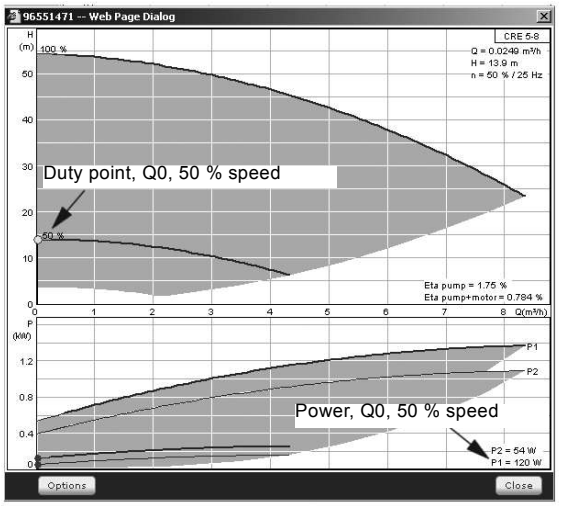


Fig. 98 Reading of power, Q0, 50 % speed (Grundfos Product Center)

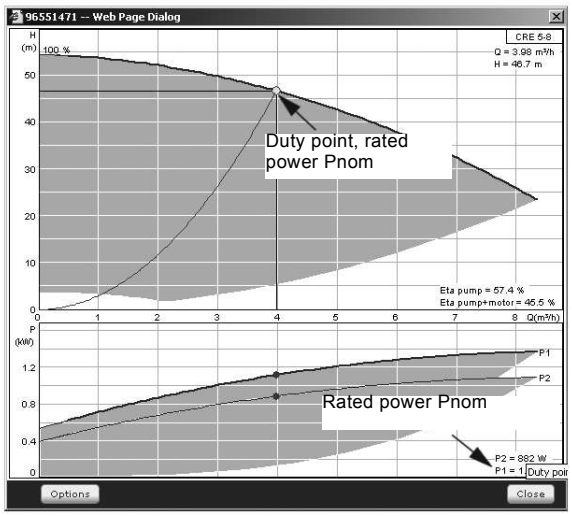


Fig. 99 Reading of rated power Pnom (Grundfos Product Center)

Qnom and Hnom are the rated duty point of the pumps and usually the duty point with the highest efficiency.

Setting via the operating panel

- Settings > Secondary functions > Pump curve data.
- Select and set:
  - Rated flow rate Qnom
  - Rated head Hnom
  - Max. head Hmax
  - Max. flow rate Qmax
  - Power, Q0, 100 % speed
  - Power, Q0, 50 % speed
  - Rated power Pnom.

9.7.42 Control source (4.3.20)

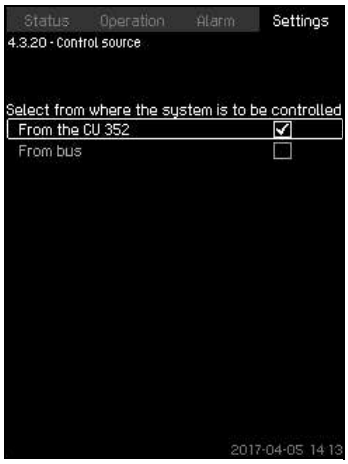


Fig. 100 Control source

Description

The system can be remote-controlled via an external bus connection (option). See section *9.8.2 GENIbus*. For further information, see section *9.8 Data communication*.

Select the control source, that is either CU 352 or the external bus connection.

Setting via the operating panel

- Settings > Secondary functions > Control source.

Factory setting

The control source is CU 352.

9.7.43 Fixed inlet pressure (4.3.22)

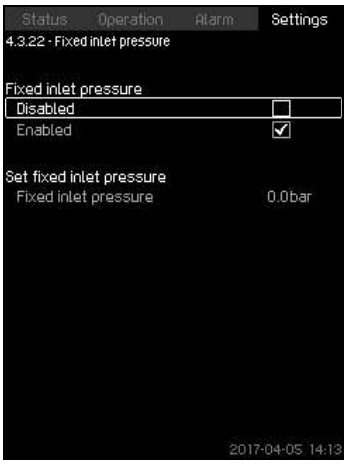


Fig. 101 Fixed inlet pressure

Description

This function is only used when no inlet-pressure sensor is fitted in the system and the inlet pressure is fixed and known.

If the pump system has a fixed inlet pressure, you can enter it in this display so that CU 352 can optimize the performance and control of the system.

Setting range

A fixed inlet pressure can be set, and the function can be enabled and disabled.

Setting via the operating panel

- Settings > Secondary functions > Fixed inlet pressure.
- Select: Enabled or Disabled.
- Set: Fixed inlet pressure.

Factory setting

The function is disabled.

9.7.44 Flow estimation (4.3.23)

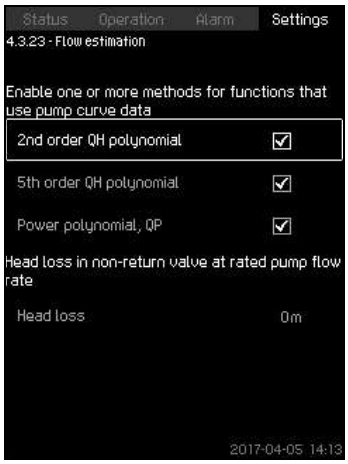


Fig. 102 Flow estimation

Description

As described in section *9.7.41 Pump curve data (4.3.19)*, CU 352 can optimize operation according to performance curves and motor data. In this display, you can select the curve types which CU 352 uses for the optimization if they are available.

At large flow rates, there may be a considerable head loss between the pump outlet flange and the pressure sensor. The loss is caused by non-return valves and pipe bends. To improve the flow estimation of the system, it is necessary to compensate for the difference between the measured and the actual differential pressure across the pump. This is done by entering the head loss in non-return valves and pipe bends at the rated flow rate of one pump.

Setting range

- 2nd order QH polynomial
- 5th order QH polynomial
- Power polynomial, QP
- Head loss

It is possible to select several curve types, as CU 352 makes a priority based on the data available.

Setting via the operating panel

- Settings > Secondary functions > Flow estimation.

Factory setting

All polynomials are selected.

9.7.45 Reduced operation (4.3.24)

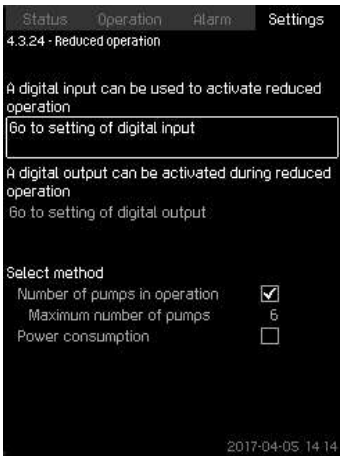


Fig. 103 Reduced operation

Description

This function allows you to limit the number of pumps in operation, or for MPC-E systems, to limit power consumption. The limit is activated by a digital input.

Setting range

- Setting of digital input (*9.7.27 Digital inputs (4.3.7)*).
- Setting of digital output (*9.7.32 Digital outputs (4.3.9)*).
- Maximum number of pumps in operation.
- Maximum power consumption.

Setting via the operating panel

- Settings > Secondary functions > Reduced operation.

1. Select: Go to setting of digital input.
2. Select digital input.
3. Select: Reduced operation.
4. Press ↩ x 2.
5. Select: Go to setting of digital output.
6. Select digital output.
7. Select: Reduced operation.
8. Press ↩ x 2.
9. Set: Number of pumps in operation or Power consumption.

Factory setting

No digital input is selected (disabled).

9.7.46 Multisensor settings (4.3.25)

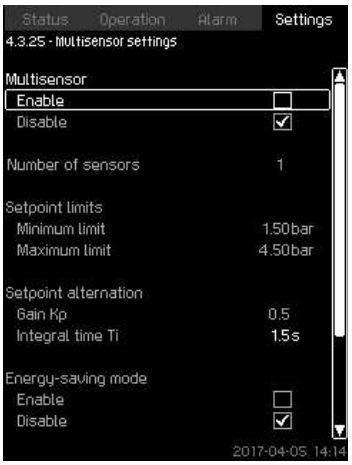


Fig. 104 Multisensor settings

Description

This function is designed for controlling up to six different zones in a HVAC system with a defined differential-pressure band. The function will if one of the "Multisensor" signals are outside the specific sensor limits (minimum/maximum) influence the setpoint (SP) up or down to insure that the specific sensor or zone is kept within its pressure band.

You can adjust the reaction of the setpoint influence by the means of dedicated "Setpoint alternation", Kp and Ti values.

In case more sensors are either under or above their limits, you can set a priority between the sensors. Furthermore, the system can optimize the actual setpoint if "Energy-saving mode" is activated, thus, the system will lower the actual setpoint until the minimum limit for one of the multisensors.

Setting range

- Number of sensors
- Setpoint limits:
  The range with the function will operate the control setpoint up or down according to the "Multisensor" feedback.
- Setpoint alternation
  - Gain Kp
  - Integral time Ti
- Energy-saving mode
  In this mode, the system ramps down the actual setpoint towards the minimum limit for one of the "Multisensor".
- Control mode
  - Minimum limit:
  In this mode, the actual setpoint will be ramped up or down by the remote sensor with the highest priority if the remote sensor is outside its "Minimum limit" or "Maximum limit".
  - Minimum mode:
  In this mode, the actual setpoint must be ramped up by the remote sensors if one or more of the remote sensors are below their "Minimum limit".

Settings via the operating panel

- Settings > Secondary functions > Multisensor settings.

1. Select: Enable.
2. Set: Number of sensors
3. Set: Setpoint limits (Select minimum and maximum).
4. Set: Setpoint alternation (Gain Kp and Integral Ti)
5. Enable "Energy-saving mode" if requested
6. Set: Control mode (Select Priority mode or Minimum mode).
7. Press "Multisensor settings" to set the individual settings for each multisensor.

9.7.47 Multisensor settings (4.3.25.1)

Fig. 105 Multisensor settings

Description

Each "Multisensor" needs to be defined in order for the function to work correctly.

Setting range

- Name
- Sensor limits
- Sensor priority (1-6, High = 1)
- Filter factor [second] (time period where the remote sensor feedback signal is averaged over.)
- Sensor source

Local = AI

Bus = BUS communication

Setting via the operating panel

- Settings > Secondary functions > Multisensor settings > Multisensor settings.

9.7.48 Monitoring functions (4.4)

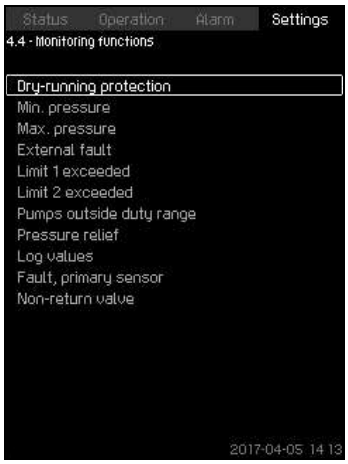


Fig. 106 Monitoring functions

Description

The system has a series of functions that constantly monitor the operation of the system.

The primary purpose of the monitoring functions is to ensure that faults do not damage pumps or the system.

Setting range

- *Dry-running protection (4.4.1)*
- *Min. pressure (4.4.2)*
- *Max. pressure (4.4.3)*
- *External fault (4.4.4)*
- *Limit 1 exceeded (4.4.5 - 4.4.6)*
- *Pumps outside duty range (4.4.7)*
- *Pressure relief (4.4.8)*
- *Log values (4.4.9)*
- *Fault, primary sensor (4.4.10)*.

Setting via the operating panel

- Settings > Monitoring functions.

9.7.49 Dry-running protection (4.4.1)

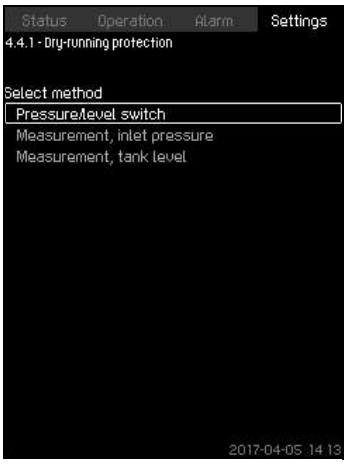


Fig. 107 Dry-running protection

Description

Dry-running protection is one of the most important monitoring functions, as the bearings and the shaft seal may be damaged if the pumps run dry. We thus always recommend that you use dry-running protection.

The function is based on monitoring of the inlet pressure or the level in a possible tank or pit on the inlet side.

Level switches, pressure switches or analog sensors signalling water shortage at a set level can be used.

There are three different methods for detection of water shortage:

- Pressure switch on inlet manifold or float switch/electrode relay in the supply tank. See section *9.7.50 Pressure/level switch (4.4.1.1)*.
- Measurement of inlet pressure in the inlet manifold by means of an analog pressure transmitter. See section *9.7.51 Measurement, inlet pressure (4.4.1.2)*.
- Measurement of level in the supply tank by means of an analog level transmitter. See section *9.7.52 Measurement, tank level (4.4.1.3)*.

Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Select method.

9.7.50 Pressure/level switch (4.4.1.1)

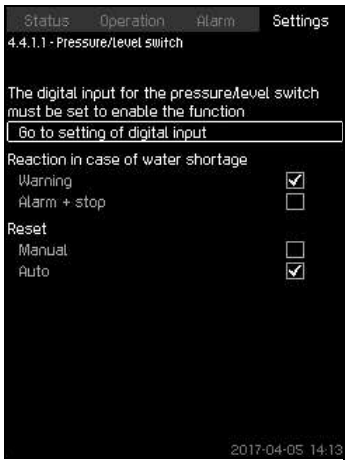


Fig. 108 Pressure/level switch

Description

This function is primarily used in boosting applications. Dry-running protection can take place by means of a pressure switch on the inlet manifold or a level switch in a tank on the inlet side.

When the contact is open, CU 352 registers water shortage after a time delay of approximately five seconds. You can set whether the indication is to be just a warning or an alarm stopping the pumps.

You can set restarting and resetting of alarms to be automatic or manual.

Setting range

- Selection of digital input for the function.
- Reaction in case of water shortage: Alarm + stop.
- Restarting: Manual or Auto.

Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Pressure/level switch > Go to setting of digital input. Display *Digital inputs (4.3.7)* appears.

1. Set the input to dry-running protection.
2. Press ⮌.
3. Select:

- Warning or Alarm + stop.
- Manual or Auto.

Factory setting

The setting is done in the startup wizard and depends on the application.

9.7.51 Measurement, inlet pressure (4.4.1.2)

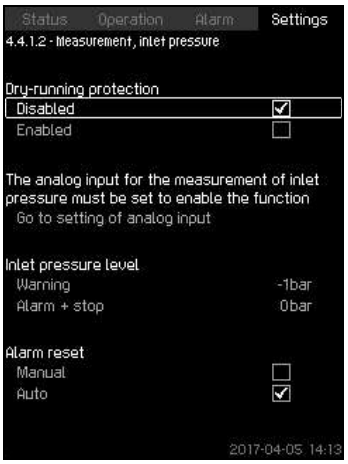


Fig. 109 Measurement, inlet pressure

Description

Dry-running protection can take place by means of a pressure transmitter measuring the inlet pressure.

You can set two levels:

- Warning
- Alarm + stop.

You can set restarting and resetting of alarms to be automatic or manual.

Setting range

- Selection of analog input for the function.
- Inlet pressure level for "Warning".
- Inlet pressure level for "Alarm + stop".
- Restarting: Manual or Auto.

Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Measurement, inlet pressure> Go to setting of analog input. Display *Analog inputs (4.3.8)* appears.

1. Select: Inlet pressure.
2. Press ⮌.
3. Select: Enabled.
4. Select and set the level:

- Warning.
- Alarm + stop.

5. Select resetting: Auto or Manual.

If one of the levels is not required, the level value must be the minimum value of the inlet-pressure transmitter. This disables the function.

Factory setting

The setting is done in the startup wizard and depends on the application.

9.7.52 Measurement, tank level (4.4.1.3)

Fig. 110 Measurement, tank level

Description

Dry-running protection can take place by means of a level transmitter measuring the level in a tank on the inlet side.

You can set two levels:

- Warning
- Alarm + stop.

You can set restarting and resetting of alarms to be automatic or manual.

Setting range

- Selection of analog input for the function.
- Tank level for "Warning".
- Tank level for "Alarm + stop".
- Restarting: Manual or Auto.

Setting via the operating panel

- Settings > Monitoring functions > Dry-running protection > Measurement, tank level > Go to setting of analog input. Display *Analog inputs (4.3.8)* appears.

1. Set the input to "Tank level, suction side".
2. Press ↩ x 3.
3. Select: Enabled.
4. Select and set the level:

- Warning.
- Alarm + stop.

5. Select alarm resetting: Manual or Auto.

Factory setting

The function is disabled.

9.7.53 Min. pressure (4.4.2)

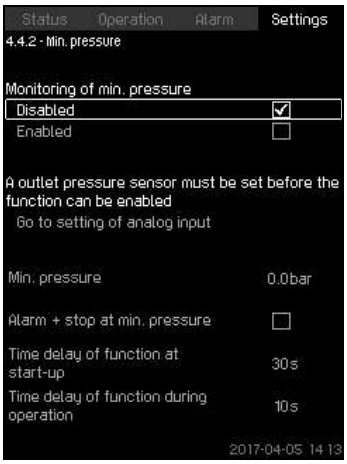


Fig. 111 Min. pressure

Description

The outlet pressure will be monitored if the application is pressure boosting. In all other applications, the system pressure will be monitored. CU 352 will react if the pressure becomes lower than a set minimum level for an adjustable time.

The minimum pressure can be monitored if a fault indication is required in situations where the outlet pressure becomes lower than the set minimum pressure.

You can set whether the indication is to be just a warning or an alarm stopping the pumps. This may be desirable if the system is used for an irrigation system where a very low outlet pressure may be due to pipe fracture and thus an extraordinarily high consumption and a very low counterpressure. In such situations, it is desirable that the system stops and indicates alarm. This situation requires manual resetting of alarms.

You can set a startup delay ensuring that the system can build up pressure before the function is enabled. You can also set a time delay, that is for how many seconds the outlet pressure may be lower than the set minimum pressure before the alarm is activated.

Setting range

- Minimum pressure level within the range of the primary sensor.
- Activation of stop when the pressure falls below the minimum pressure.
- Time delay of function at start-up.
- Time delay of function during operation.

Setting via the operating panel

- Settings > Monitoring functions > Min. pressure > Enabled.

1. Select and set: Min. pressure.
2. Select: Alarm + stop at min. pressure.
3. Set:

- Time delay of function at start-up
- Time delay of function during operation.

Factory setting

The function is disabled.

9.7.54 Max. pressure (4.4.3)

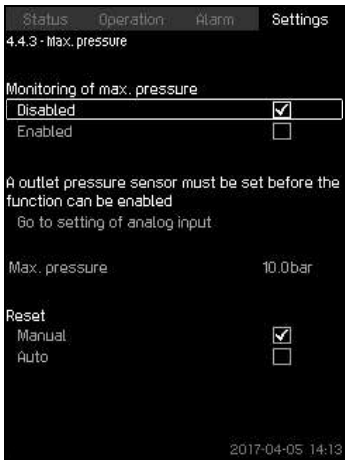


Fig. 112 Max. pressure

Description

The outlet pressure will be monitored if the application is pressure boosting. In all other applications, the system pressure will be monitored. CU 352 will react if the pressure becomes higher than a set maximum level.

In certain installations, a too high outlet pressure may cause damage. It may therefore be necessary to stop all pumps for a short period if the pressure is too high.

You can set whether the system is to restart automatically after the pressure has dropped below the maximum level, or if the system must be reset manually. Restarting will be delayed by an adjustable time. See section *9.7.14 Min. time between start/stop (4.2.1)*.

Setting range

- Maximum pressure level within the range of the primary sensor.
- Manual or automatic restarting.

Setting via the operating panel

- Settings > Monitoring functions > Max. pressure > Enabled.

4. Set: Max. pressure.
5. Select resetting: Manual or Auto.

Factory setting

The function is disabled.

9.7.55 External fault (4.4.4)

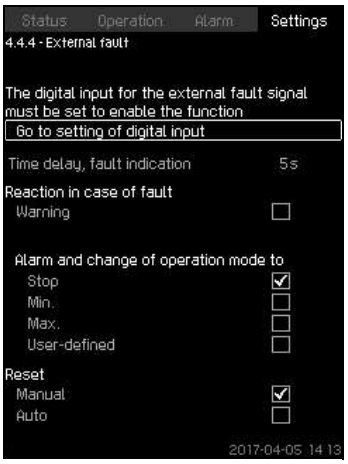


Fig. 113 External fault

Description

The function is used when CU 352 is to be able to receive a fault signal from an external contact. In case of external fault, CU 352 indicates warning or alarm. In case of alarm, the system changes to another manual operating mode, for instance "Stop".

Setting range

- Selection of digital input for the function.
- Setting of time delay from closing of the contact until CU 352 reacts.
- Reaction in case of external fault: Warning or alarm and change of operating mode.
- Restarting after alarm: Manual or Auto.

Setting via the operating panel

- Settings > Monitoring functions > External fault > Go to setting of digital input. Display *Digital inputs (4.3.7)* appears.

6. Set the input to "External fault".
7. Press ↩.
8. Set: Time delay, fault indication.
9. If only a warning is required in case of external fault, select "Warning".
   If the system is to give alarm and change operating mode in case of external fault, select operating mode "Manual" or "Auto".

Factory setting

The function is disabled. If the function is enabled, the following values have been set from factory:

- Time delay: 5 seconds.
- Operating mode in case of alarm: Stop.
- Restarting: Manual.

9.7.56 Limit 1 exceeded (4.4.5 - 4.4.6)

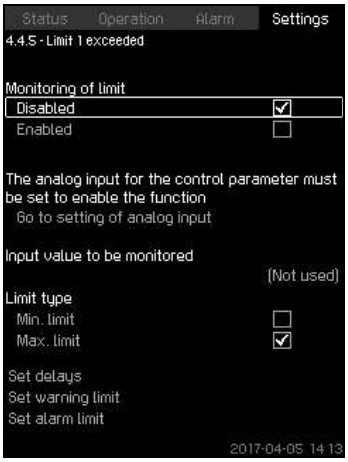


Fig. 114 Limit 1 exceeded

Description

With this function, CU 352 can monitor set limits of analog values. It will react if the values exceed the limits. Each limit can be set as a maximum or minimum value. For each of the monitored values, a warning limit and an alarm limit must be defined.

The function allows you to monitor two different locations in a pump system at the same time, for instance the pressure at a consumer and the pump's outlet pressure. This ensures that the outlet pressure does not reach a critical value.

If the value exceeds the warning limit, a warning is given. If the value exceeds the alarm limit, the pumps will be stopped.

You can set a delay between the detection of an exceeded limit and the activation of a warning or an alarm. You can also set a delay for resetting a warning or an alarm.

A warning can be reset automatically or manually.

You can set whether the system is to restart automatically after an alarm, or if the alarm must be reset manually. Restarting can be delayed by an adjustable time. You can also set a startup delay ensuring that the system reaches a steady state before the function becomes active.

Setting range

- Selection of analog input for the function
- Input value to be monitored
- Limit type (Min. limit and Max. limit)
- warning limit
- alarm limit.

Setting via the operating panel

Analog inputs must be correctly set before the function is enabled. See section *9.7.29 Analog inputs (4.3.8)*.

- Settings > Monitoring functions > Limit 1 exceeded / Limit 2 exceeded > Go to setting of analog input.

1. Select analog input.
2. Select: Input value to be monitored. Display 4.3.8.1.1 appears.
3. Select input.
4. Press ↩.
5. Set the minimum and maximum sensor value.
6. Press ↩ x 2.
7. Select: Input value to be monitored.
8. Select input.
9. Press ↩.
10. Select:
- Min. limit or Max. limit.
- Set delays.

11. Press ↩.
12. Select:
- Set warning limit
- Enabled.

13. Set limit.
14. Select resetting: Manual or Auto.
15. Press ↩.
16. Select:
- Set alarm limit
- Enabled.

17. Set limit.
18. Select resetting: Manual or Auto.
19. Press ↩.
20. Select: Enabled.

Factory setting

The function is disabled.

9.7.57 Pumps outside duty range (4.4.7)

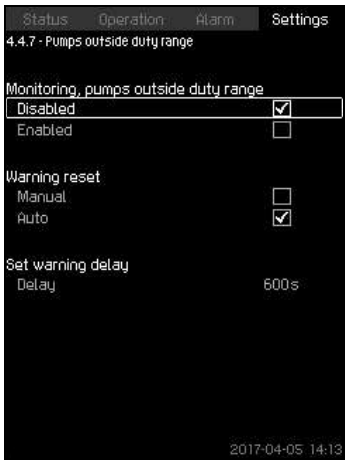


Fig. 115 Pumps outside duty range

Description

The function gives a warning if the duty point of the pumps moves outside the defined range. For instance, if the inlet pressure becomes lower than a minimum permissible value, thus causing a risk of cavitation for some pump types.

The warning is given with a set time delay. You can set whether the warning is to be reset automatically or manually when the duty point comes within the defined duty range. You can also set a relay output to be activated when the warning is given, and to be deactivated when the warning is reset.

This function requires that the outlet pressure and the inlet pressure (either measured or configured) or the differential pressure of the pumps is monitored, and that CU 352 contains valid pump data from either a GSC file or from manual input. See section *9.7.41 Pump curve data (4.3.19)*.

Setting range

- Setting of manual or automatic resetting.
- Setting of warning delay.

Setting via the operating panel

- Settings > Monitoring functions > Pumps outside duty range > Manual / Auto > Set warning delay.

Factory setting

The function is disabled.

9.7.58 Pressure relief (4.4.8)

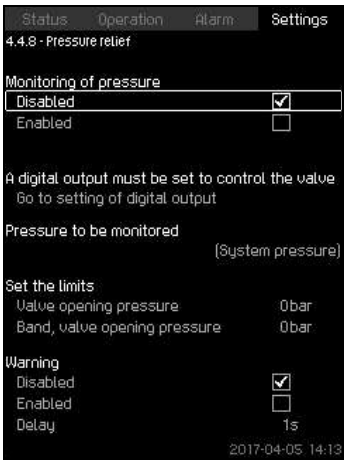
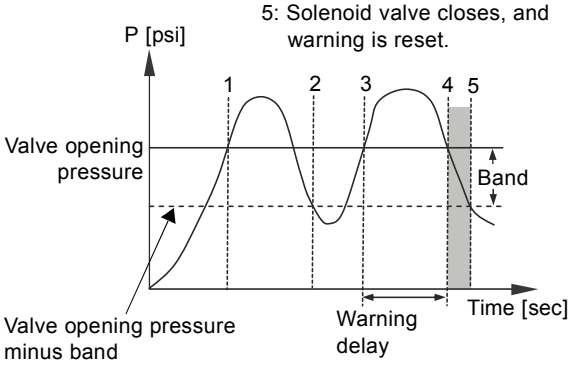


Fig. 116 Pressure relief

Description

The purpose of the function is to reduce the pressure in the pipes by opening a solenoid valve if it exceeds a set limit. If the pressure is not reduced within a given time, the solenoid valve will be closed, and a warning can be given.

1: Solenoid valve opens.
2: Solenoid valve closes.
3: Solenoid valve opens.
4: Warning is activated.
5: Solenoid valve closes, and warning is reset.



TM03 9206 3607

Fig. 117 Pressure relief

Setting range

- Setting of digital output.
- Setting of pressure to be monitored.
- Setting of valve opening pressure.
- Setting of band for valve opening pressure.
- Setting of warning or alarm.

Setting via the operating panel

- Settings > Monitoring functions > Pressure relief > Go to setting of digital output.

1. Select digital output.
2. Select: Pressure relief valve.
3. Press ↩ x 2.
4. Select: Pressure to be monitored

- Select: Outlet pressure, System pressure or External pressure.

5. Press ↩.
6. Select and set:

- Valve opening pressure
- Band, valve opening pressure.

7. Select: Warning > Disabled or Enabled.
8. Set: Delay. (Only to be set if warning has been enabled).
9. Select: Enabled.

Factory setting

The function is disabled.

9.7.59 Log values (4.4.9)

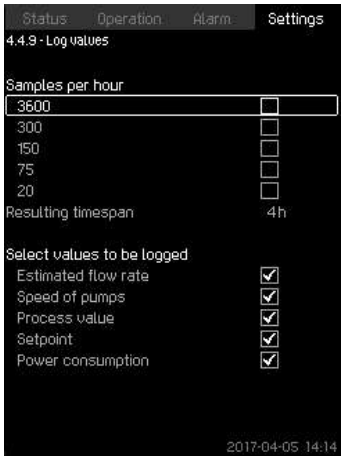


Fig. 118 Log values

Description

Select the values to be logged and the number of samples per hour. The resulting timespan is shown. When the timespan has elapsed, old logged values will be deleted and overwritten by the new ones.

Log values

- Estimated flow rate (only if no flowmeter is installed)
- Speed of pumps
- Process value
- Setpoint
- Power consumption (MPC-E systems)
- Inlet pressure (if an inlet-pressure sensor is installed).

Setting range

Samples per hour: 1-3600.

Setting via the operating panel

- Settings > Monitoring functions > Log values.

1. Set: Samples per hour.
2. Select the values to be logged.

9.7.60 Fault, primary sensor (4.4.10)

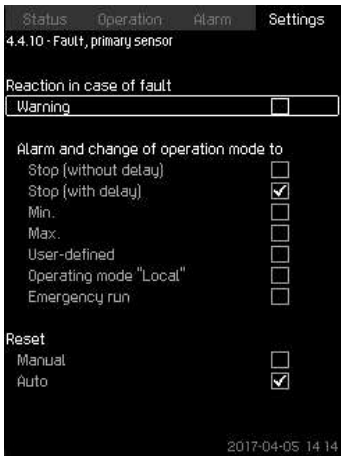


Fig. 119 Fault, primary sensor

Description

You can set how the system is to react if the primary sensor fails.

Setting range

- Stop (without delay)
- Stop (with delay)
- Min.
- Max.
- User-defined
- Operating mode "Local"
- Emergency run
- Reset: Manual or Auto.

Setting via the operating panel

- Settings > Monitoring functions > Fault, primary sensor.

1. Select reaction in case of a fault in the primary sensor.
2. Select resetting: Manual or Auto.

9.7.61 Non-return valve (4.4.11)

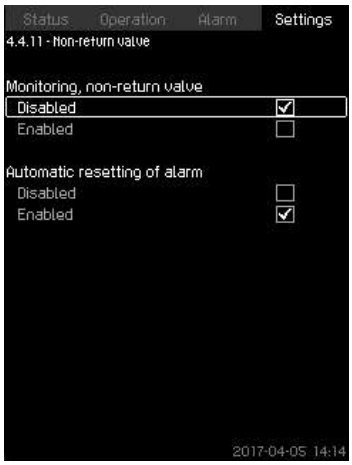


Fig. 120 Non-return valve

Description

This function enables CU 352 to detect if a "Non-return valve" is leaking or faulty. A small leakage will after five accumulated incidents result in a warning. A faulty NRV will instantly result in an alarm and pump stop. In this case the motor is not able to overcome the backflow through the pump with the faulty NRV.

The function is only valid for a MPC-E system with MLE motors model G, H, I or J.

Setting range

- Monitoring, non-return valve: Enabled or Disabled.
- Automatic resetting of alarm: Enabled or Disabled.

Setting via the operating panel

- Settings > Monitoring functions > Non-return valve

1. Enable the function.
2. Select if "Automatic resetting of alarm" is to be "Disabled".

Factory setting

The function is "Enabled".

9.7.62 Functions, CU 352 (4.5)

Fig. 121 Functions, CU 352

Description

Make the basic settings of CU 352 in this submenu.

CU 352 comes with most of these settings, or they are made at startup and normally not to be changed.

The service language, English, can be selected for service purposes. If no buttons are touched for 15 minutes, the display returns to the language selected at startup or to the language set in *Display language (4.5.1)*.

If the service language is selected, the symbol is to the right in the top line of all displays.

Setting range

- Activation of service language, British English.
- Re-activation of startup wizard. (After startup, the wizard is inactive.)
- Selection of "Display language".
- Selection of display units.
- Setting of "Date and time".
- Selection of password for menu "Operation" and "Settings".
- Setting of "Ethernet" communication.
- Setting of "GENIbus number".
- Reading of "Software status".

9.7.63 Display language (4.5.1)

Fig. 122 Display language

Description

Here you select the language for the CU 352 display.

Setting range

- English
- German
- Danish
- Spanish
- Finnish
- French
- Greek
- Italian
- Dutch
- Polish
- Portuguese
- Russian
- Swedish
- Chinese
- Korean
- Japanese
- Czech
- Turkish
- Hungarian
- Bulgarian
- Croatian
- Latvian
- Lithuanian
- Romania
- Slovak
- Slovenian
- Serbian Latin
- US English
- Indonesian
- Malay
- Estonian.

Setting via the operating panel

- Settings > Functions, CU 352 > Display language.

Factory setting

The display language is English. It can be changed at startup.

9.7.64 Units (4.5.2)

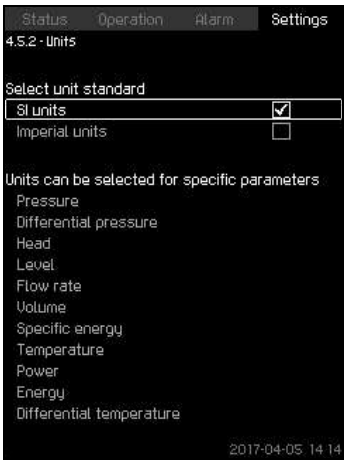


Fig. 123 Units

Description

Here you can select units for the various parameters.

Select between SI and imperial units. You can also select other units for the individual parameters.

Setting range

Parameter	Basic setting		Possible units
	SI	Imperial	
Pressure	bar	psi	kPa, MPa, mbar, bar, m, psi
Differential pressure	m	psi	kPa, MPa, mbar, bar, m, psi
Head	m	ft	m, cm, ft, in
Level	m	ft	m, cm, ft, in
Flow rate	m^3/h	gpm	m^3/s, m^3/h, l/s, gpm, yd^3/s, yd^3/min, yd^3/h
Volume	m^3	gal	l, m^3, gal, yd^3
Specific energy	kWh/m^3	Wh/gal	kWh/m^3, Wh/gal, Wh/kgal, BTU/gal, HPh/gal
Temperature	°C	°F	K, °C, °F
Differential temperature	K	K	K
Power	kW	HP	W, kW, MW, HP
Energy	kWh	kWh	kWh, MWh, BTU, HPh

If units are changed from SI to imperial or vice versa, all individually set parameters will be changed to the basic setting in question.

Setting via the operating panel

- Settings > Functions, CU 352 > Units.

Set unit standard, measuring parameter and specific unit. See the example in fig. 124.

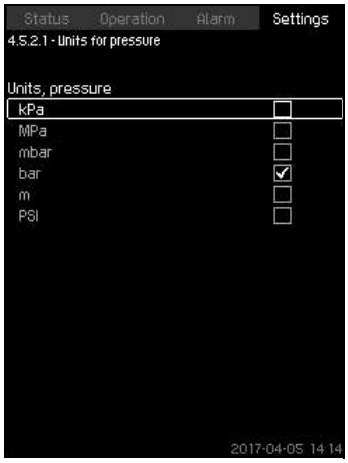


Fig. 124 Example of selection of units

Factory setting

The setting is done in the startup wizard and depends on the application.

9.7.65 Date and time (4.5.3)

Fig. 125 Date and time

Description

You can set date and time as well as how they are to be shown in the display.

The clock has a built-in rechargeable voltage supply which can supply the clock for up to 20 days if the voltage supply to the system is interrupted.

If the clock is without voltage for more than 20 days, it must be set again.

Setting range

The date can be set as day, month and year. The time can be set as a 24-hour clock showing hours and minutes.

There are three formats.

Examples of format
2012-09-27 13:49
27-09-2012 13:49
9/27/2012 1:49 pm

You can also select if Sunday or Monday is to be the first day of week.

Setting via the operating panel

- Settings > Functions, CU 352 > Date and time.

1. Select and set:
- Day, Month, Year, Hours, Minutes.
2. Select format.
3. Select "Sunday" or "Monday" under "First day of week".

Factory setting

Local time.

If the system has been without voltage for more than 20 days since it left the factory, the clock may have returned to the original setting: 01-01-2005 0:00.

Date and time may have been changed during the setting of system.

There is no automatic changeover to/from daylight-saving time.

9.7.66 Password (4.5.4)

Fig. 126 Password

Description

You can limit the access to the menus "Operation" and "Settings" by means of a password. If the access is limited, it is not possible to view or set any parameters in the menus.

The password must consist of four digits and may be used for both menus.

If you have forgotten the password(s), contact Grundfos.

Setting via the operating panel

- Settings > Functions, CU 352 > Password.

1. Select the password to be enabled.
2. Select: Enter password.
   The first digit of the password is flashing.
3. Select digit.
   The second digit of the password is flashing.
4. Repeat these steps if it is necessary to enable the other password.

Factory setting

Both passwords are disabled. If a password is enabled, the factory setting will be "1234".

9.7.67 Ethernet (4.5.5)

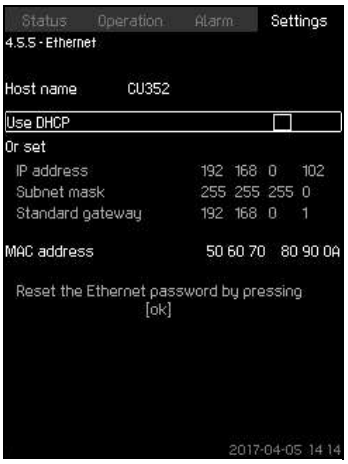


Fig. 127 Ethernet

Description

CU 352 is equipped with an Ethernet connection for communication with a computer, either direct or via Internet. See also section *9.8.1 Ethernet*.

9.7.68 GENIbus number (4.5.6)

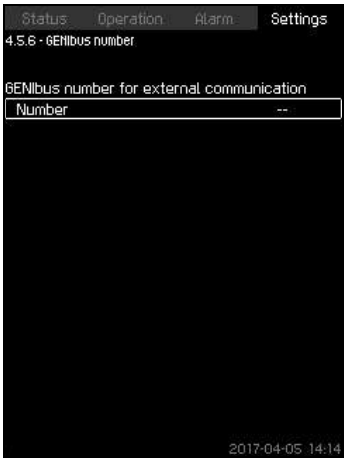


Fig. 128GENIbus number

Description

CU 352 can communicate with external units via an RS-485 interface (option). For further information, see fig. 132 and section *7. Click [Apply].*

Communication is carried out according to the Grundfos bus protocol, GENIbus, and enables connection to a building management system or another external control system.

Operating parameters, such as setpoint and operating mode, can be set via the bus signal. Furthermore, status about important parameters, such as actual value and input power, and fault indications can be read from CU 352.

Contact Grundfos for further information.

Setting range

The number can be set between 1 and 64.

Setting via the operating panel

- Settings > Functions, CU 352 > GENIbus number.

Factory setting

No number has been set.

9.7.69 Software status (4.5.9)

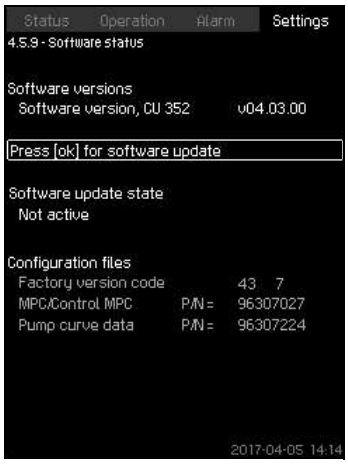


Fig. 129 Software status

Description

This display shows the status of the software installed in CU 352. Furthermore, the version code and the product numbers of configuration files (GSC) read into the unit are shown. You can also upgrade the software version. Contact Grundfos for further information.

9.7.70 Status display menu (4.6)

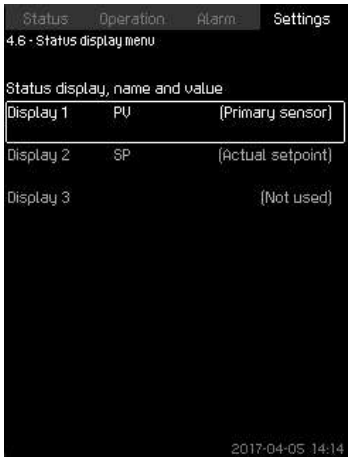


Fig. 130 Status display menu

Description

In the main status menu, you can have up to three status values displayed.

In this menu, you can define each status value to be displayed and define a short name for the value.

PV = Process Value

SP = Setpoint

Q = Flow

Setting range

Name of each display value

Function type for Display 1-3

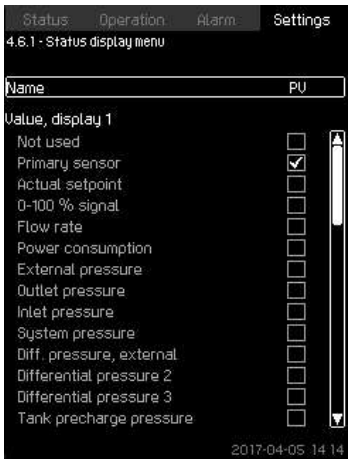


Fig. 131 Status display menu (4.6.1)

Setting in operating panel

- Settings > Status display menu

1. Select display 1, 2 or 3, press [OK].
2. Define a name for display.
3. Select the value for the display 1, 2 or 3.

Factory settings

Display 1: PV, Primary sensor

Display 2: SP, Actual setpoint

9.8 Data communication

CU 352 is equipped with a hardware enabling communication with external units, such as a computer, via an external GENIbus or ethernet connection.

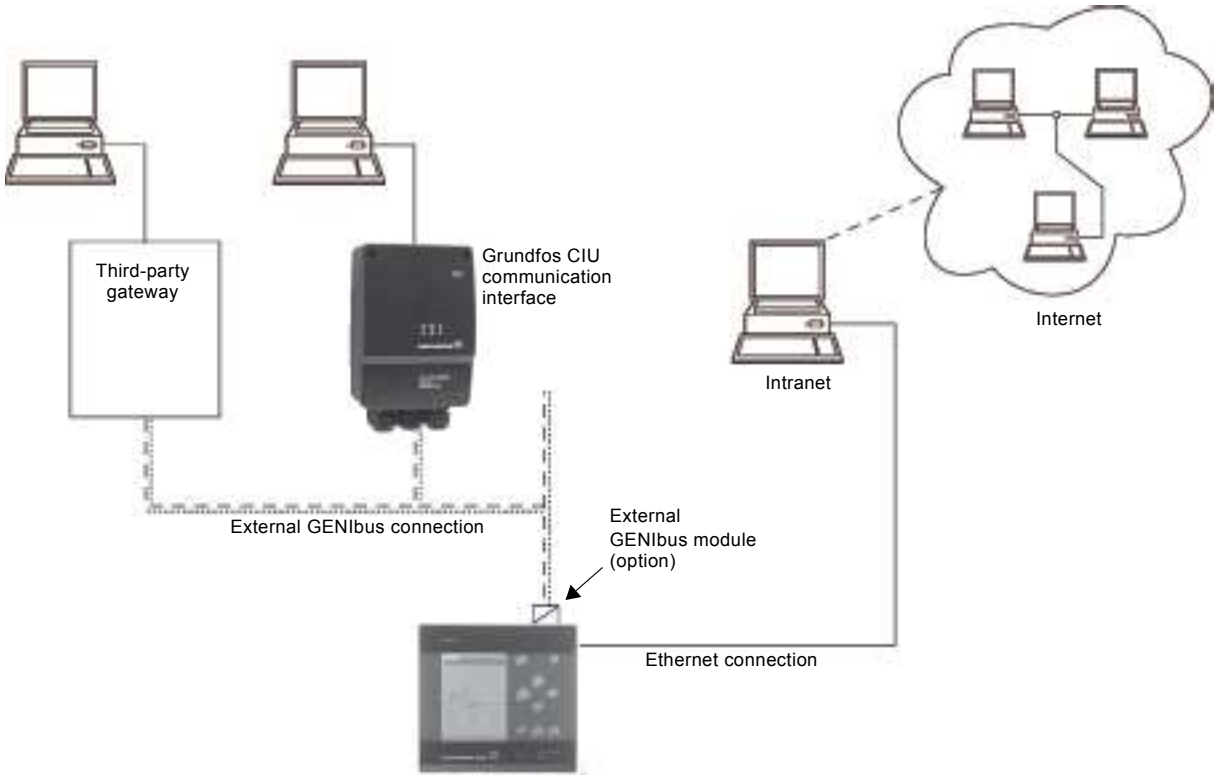


Fig. 132 Data communication via external GENIbus and ethernet connection

9.8.1 Ethernet

Ethernet is the most widely used standard for local networks (LAN). The standardization of this technology has created some of the easiest and cheapest ways of creating communication between electric units, for instance between computers or between computers and control units.

The webserver of CU 352 makes it possible to connect a computer to CU 352 via an ethernet connection. The user interface can thus be exported from CU 352 to a computer so that CU 352 and consequently the system can be monitored and controlled externally.

We recommend that you protect the connection to CU 352 according to your safety requirements in consultation with the system administrator.

In order to use the webserver, you must know the IP address of CU 352. All network units must have a unique IP address to communicate with each other. The IP address of CU 352 from factory is 192.168.0.102.

Alternatively to the factory-set IP address, it is possible to use a dynamic assignment of IP address. This is possible by activating a DHCP (Dynamic Host Configuration Protocol) in CU 352 or via the webserver. See the example in fig. 133.

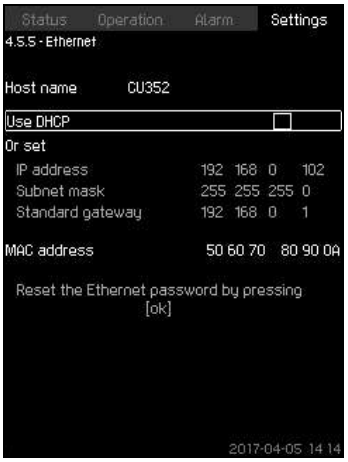


Fig. 133 Example of setting of Ethernet

Dynamic assignment of an IP address for CU 352 requires a DHCP server in the network. The DHCP server assigns a number of IP addresses to the electric units and makes sure that two units do not receive the same IP address.

A standard internet browser is used for connection to the webserver of CU 352.

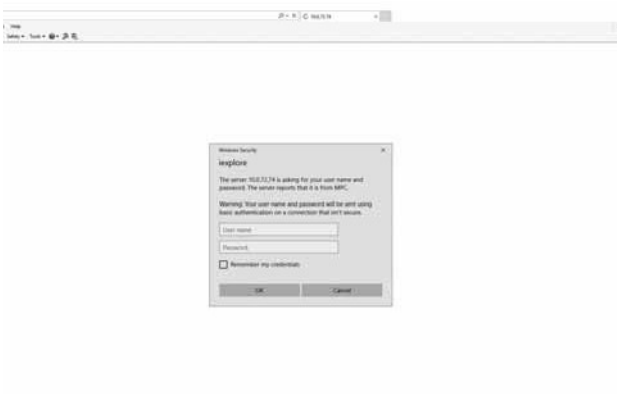
If you want to use the factory-set IP address, no changes are required in the display. Open the internet browser and enter the IP address of CU 352.

If you want to use dynamic assignment, you must enable the function by selecting "Use DHCP" and clicking [ok]. A check mark shows that the function has been enabled.

Open the internet browser and enter the host name of CU 352 instead of the IP address. The internet browser will now try to connect to CU 352. The host name can be read in the display, but can only be changed by either a GSC file (configuration file) or via a webserver. See section *Change of network setting* on page 72.

A host name is required to use DHCP.

This is the first display shown when connecting to CU 352.



TM03 2048 0517

Fig. 134 Connection to CU 352

Factory setting

User name:	admin
Password:	admin

When you have entered the user name and password, an application starts up in CU 352, provided that a Java Applet has been installed on the computer. If this is not the case, but the computer is connected to the internet, then use the link on the screen to download and install the Java Applet.

The application on CU 352 exports the Java Applet to your browser and gives you access to user interfaces such as display and operating panel.

The Java Applet installation in the browser must be accepted by the user. You can now monitor and control CU 352 from a computer.

TM05 3236 0517

Fig. 135 Network setting

Change of network setting

When connection to the webserver of CU 352 has been established, you can change the network setting.

TM03 2050 3505

Fig. 136 Change of network setting

1. Click [>Network admin].
2. Enter the changes.
3. Click [Submit] enable the changes.

Administrator configuration

TM03 2051 0517

Fig. 137 Change of user name and password

1. Click [>Admin config].
2. Enter new user name if applicable.
3. Click [Apply].
4. Enter existing password.
5. Enter new password.
6. Repeat new password.
7. Click [Apply].

9.8.2 GENIbus

By installing a GENIbus module in CU 352, you can connect the system to an external network. The connection can take place via a GENIbus-based network or a network based on another fieldbus protocol via a gateway. See examples in fig. 132. For further information, contact Grundfos.

The gateway may be a Grundfos CIU communication interface or a third-party gateway. For further information on CIU, see Grundfos Product Center, or contact Grundfos.

10. Servicing the product

WARNING

Electric shock

Death or serious personal injury
- Switch off the power supply before you start any work on the product.
- Lock the main switch with a padlock to ensure that the power supply cannot be accidentally switched on.

10.1 Maintaining the product

10.1.1 Pumps

Pump bearings and shaft seal are maintenance-free.

10.1.2 CU 352

CU 352 is maintenance-free. Keep the unit clean and dry, and protect it against direct sunlight. For ambient temperature, see section *14. Technical data*.

10.1.3 Motor bearings

Motors without lubricating nipples are maintenance-free.

Lubricate motors with lubricating nipples with a high-temperature lithium-based grease. See the instructions on the fan cover of Grundfos motors.

In the case of seasonal operation where the motor is idle for more than six months of the year, we recommend that you grease the motor when you take the pump out of operation.

11. Protecting the product against frost

If pumps are not used during periods of frost, they must be drained to avoid damage.

Follow these instructions:

1. Loosen the vent screw in the pump head.
2. Remove the drain plug from the base.

WARNING

Electric shock

Death or serious personal injury
- Make sure that the escaping hot or cold liquid does not cause injury to persons or damage to the equipment.

Do not tighten the vent screw and fit the drain plug until the pump is to be used again.

12. Taking the product out of operation

Switch off the main switch to take the pump system out of operation.

WARNING

Electric shock

Death or serious personal injury
- Do not touch the conductors in front of the main switch as they are still energized.
- Lock the main switch with a padlock to ensure that the power supply cannot be accidentally switched on.

Take individual pumps out of operation by switching off the corresponding motor-protective circuit breaker, automatic circuit breaker or fuse.

13. Fault finding

WARNING

Electric shock

Death or serious personal injury

- Switch off the power supply for at least five minutes before you start any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

Fault	Possible cause	Remedy
1. The pumps are not running.	a) The actual pressure is higher than or equal to the setpoint.	Wait until the pressure has dropped, or lower the pressure on the outlet side of the pump system. Check that the pumps start.
	b) The power supply has been switched off.	Connect the power supply.
	c) The main switch has cut out.	Cut in the main switch.
	d) The main switch is defective.	Replace the main switch.
	e) The motor protection has been activated.	Contact Grundfos.
	f) The motor is defective.	Repair or replace the motor.
	g) The pressure transmitter is defective.	Replace the pressure transmitter. Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the pump system.
	h) The cable is broken or short-circuited.	Repair or replace the cable.
2. The pumps start, but stop immediately. The operating pressure is not reached.	a) Water shortage or no inlet pressure.	Re-establish the supply of water to the pump system. When the inlet pressure has been re-established, the pumps will restart after 15 seconds.
3. The pump system has stopped and cannot restart.	a) The pressure transmitter is defective.	Replace the pressure transmitter. Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the pump system.
	b) The cable is broken or short-circuited.	Repair or replace the cable.
	c) The power supply to CU 352 has been switched off.	Connect the power supply.
	d) CU 352 is defective.	Contact Grundfos.
4. Unstable water supply from the pump system.	a) The inlet pressure is too low.	Check the inlet pipe and the inlet strainer, if any.
	b) The inlet pipe, strainer or pumps are partly blocked by impurities.	Clean the inlet pipe, strainer or pumps.
	c) The pumps suck air.	Check the inlet pipe for leakages.
	d) The pressure transmitter is defective.	Replace the pressure transmitter.
5. The pumps are running, but deliver no water.	a) The valves are closed.	Open the valves.
	b) The inlet pipe or pumps are blocked by impurities.	Clean the inlet pipe or pumps.
	c) The non-return valve is blocked in the closed position.	Clean the non-return valve. Check that the non-return valve moves freely.
	d) The inlet pipe is leaky.	Check the inlet pipe for leakages.
	e) There is air in the inlet pipe or pumps.	Vent and prime the pumps. Check the inlet pipe for leakages.
6. The pump system is unable to reach the setpoint.	a) The consumption is too high.	• Reduce the consumption, if possible. • Install a bigger pump system.
	b) Too many standby pumps have been selected.	Reduce the number of standby pumps.
	c) There is a pipe fracture or a leakage in the system.	Check the system, and repair the damaged parts, if necessary.
7. Leakage from the shaft seal.	a) The shaft seal is defective.	Replace the shaft seal.
	b) The height adjustment of the pump shaft is inaccurate.	Readjust the shaft height.
8. Noise.	a) The pumps are cavitating.	Clean the inlet pipe or pumps and possibly the inlet strainer.
	b) The pumps do not rotate freely (frictional resistance) due to inaccurate height adjustment of the pump shaft.	Readjust the shaft height.
9. Very frequent starts and stops.	a) The diaphragm tank precharge pressure is not correct.	Set the correct precharge pressure.

14. Technical data

14.1 Pressure

Inlet pressure

The Hydro MPC pump systems can operate with a positive inlet pressure (precharged pressure system) or with a negative inlet pressure (vacuum at the inlet manifold).

We recommend that you calculate the inlet pressure in these cases:

- Water is drawn through long pipes.
- Water is drawn from depths.
- Inlet conditions are poor.

In this document, the term "inlet pressure" is defined as the pressure or vacuum which can be measured immediately before the pump system.

To avoid cavitation, make sure that there is a minimum inlet pressure on the inlet side of the pump system. The minimum inlet pressure in bar can be calculated as follows:

$H = P_b - NPSH - H_f - H_v - H_s$

P_b = Barometric pressure in feet (33.9 feet at sea level). In closed systems, P_b indicates system pressure in feet.

NPSH = **N**et **P**ositive **S**uction **H**ead in feet. NPSH can be read from the NPSH curve at the maximum capacity at which the pump will run. See the installation and operating instructions for CR, CRI, CRN.

H_f = Friction loss in inlet piping in feet at the highest flow the pump will be delivering.

H_v = Vapor pressure in feet.

H_s = Safety margin of minimum 2 ft head.

P (psi) = H/2.31

If "H" is positive, the pump can operate at a suction lift of maximum "H" feet. If "H" is negative, an inlet pressure (psia) of minimum "H" feet is required.

Maximum inlet pressure

See the CR, CRI, CRN installation and operating instructions (96462123) delivered together with this pump system.

Operating pressure

As standard, the maximum operating pressure is 232 psi (16 bar) for Hydro MPC CR(E) and is 145 psi (10 bar) for Hydro MPC CME.

On request, Grundfos offers Hydro MPC pump systems with a maximum operating pressure higher than 232 psi (16 bar).

14.2 Temperatures

Liquid temperature:

– for systems with CR(E) 3, CR(E) 5, CME 3 and CME 5 pump models	32 to 140 °F (0 to 60 °C).
– for all other pump models	32 to 180 °F (0-82 °C).

Ambient temperature: 0 to 104 °F (0 to 40 °C).

14.3 Relative humidity

Maximum: 95 %.

14.4 Sound pressure level

See the installation and operating instructions for the CR pumps.

The sound pressure level for a number of pumps can be calculated as follows:

Lmax = Lpump + (n - 1) x 3

Lmax = Maximum sound pressure level

Lpump = Sound pressure level for one pump

n = Number of pumps

14.5 Electrical data

Supply voltage

See the nameplate.

Backup fuse

See the wiring diagram supplied with the system.

Digital inputs

Open-circuit voltage	24 VDC
Closed-circuit current	5 mA, DC
Frequency range	0-4 Hz

All digital inputs are supplied with PELV voltage (Protective Extra-Low Voltage).

Analog inputs

Input current and voltage	0-20 mA 4-20 mA 0-10 V
Tolerance	± 3.3 % of full scale
Repetitive accuracy	± 1 % of full scale
Input resistance, current	< 250 Ω
Input resistance, voltage, CU 352	50 kΩ ± 10 %
Input resistance, voltage, IO 351	> 50 kΩ ± 10 %
Supply to sensor	24 V, maximum 50 mA, short-circuit protected

All analog inputs are supplied with PELV voltage (Protective Extra-Low Voltage).

Digital outputs (relay outputs)

Maximum contact load	240 VAC, 2 A
Minimum contact load	5 VDC, 10 mA

All digital outputs are potential-free relay contacts.

Some outputs have a common C terminal.

For further information, see the wiring diagram supplied with the pump system.

Inputs for PTC sensor or thermal switch

For PTC sensors to DIN 44082. Thermal switches can also be connected.

Open-circuit voltage	12 VDC ± 15 %
Closed-circuit current	2.6 mA, DC

Inputs for PTC sensors are electrically separated from the other inputs and outputs of the pump system.

15. Related documents

You find further product information about the pump system in the following documents.

All documents are available in Grundfos Product Center: www.grundfos.com > International website > Grundfos Product Center.

Title	Frequency [Hz]	Publication number
Data booklets		
Grundfos Hydro MPC CME	60	99537904
Installation and operating instructions		
CR, CRI, CRN	50/60	98419736
CRE, CRIE, CRNE, CRKE, SPKE, MTRE, CHIE*	60	98566351
Frequency converter**	50/60	-
Diaphragm tank	-	98817081
Service documentation		
Service instructions	50/60	96646712
Service kit catalogue	50/60	96488862
Other documentation		
***	-	-

* The instructions are only relevant for Hydro MPC-E, S pump systems.

** The instructions are only relevant for Hydro MPC pump systems with external frequency converter.

*** A wiring diagram is supplied with the pump system.

16. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

GRUNDFOS Kansas City
9300 Loiret Blvd.
Lenexa, Kansas 66219
Phone: (913) 227-3400
Fax: (913) 227-3500

www.grundfos.us

GRUNDFOS Canada
2941 Brighton Road
Oakville, Ontario L6H 6C9 Canada
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

www.grundfos.ca

GRUNDFOS México
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
C.P. 66600 Apodaca, N.L. México
Phone: 011-52-81-8144 4000
Fax: 011-52-81-8144 4010

www.grundfos.mx

L-BPQ-TL-01

99320238 0919

ECM: 1269866

CR, CRI, CRN, CRT

Installation and operating instructions

(2) CR45-3-1 Pumps used in HydroMPC-EC System for Alternate Option

be
think
innovate

GRUNDFOS

Table of contents

Original installation and operating instructions.

CONTENTS

Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

Warning

Electrical work: All electrical work should be performed by a qualified electrician in accordance with the latest edition of national, state, and local codes and regulations.

Warning

Shock Hazard: A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation. In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

1. Limited warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions.
Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

2. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment.***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

3. Introduction

The CR range is based on the inline multistage centrifugal pump first pioneered by Grundfos. CR is available in four basic materials and over one million configurations. CR is suitable for pumping water and water-like liquids in industry, petrochemical plants, water treatment plants, commercial buildings, and many other applications. Some of the outstanding characteristics of CR are:

- superior efficiency
- reliability
- easy maintenance
- compact size and small footprint
- quiet operation.

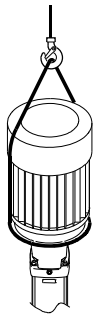
4. Shipment inspection

Examine the components carefully to make sure no damage has occurred to the pump during shipment. Ensure that the pump is NOT dropped or mishandled.

4.1 Lifting instructions

Caution ***Do not use the lifting eyes of the motor for lifting the entire pump and motor assembly.***

Lift pump assembly with lifting straps that pass through the motor stool. Ensure that the load is not applied to the pump shaft.



TM04 0339 0608

Fig. 1 Correct lifting of a CR pump

4.2 Ensure you have the right pump

Check the pump nameplate to make sure that it is the one you ordered.

- **CR:** Centrifugal pump; all parts in contact with the pumped liquid are made of standard cast iron and AISI 304 stainless steel
- **CRI:** Centrifugal pump; all parts in contact with the pumped liquid are made of AISI 304 stainless steel
- **CRN:** Centrifugal pump; all parts in contact with the pumped liquid are made of AISI 316 stainless steel
- **CRT:** Centrifugal pump; all parts in contact with the pumped liquid are made of titanium
- **CRE:** Centrifugal pump with a Grundfos MLE variable frequency drive motor.

4.3 Checking the condition of the pump

The packing in which your pump arrived is specially designed for your pump to prevent damage during shipment. As a precaution, leave the pump in the packing until you are ready to install it. Examine the pump for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

Note ***If the shipment consists of a complete unit (motor attached to pump end), the position of the coupling connecting the pump shaft to the motor shaft is set to factory specifications.***
No adjustment is required. If the shipment is a pump end without motor, follow the adjustment procedures in section 13. Replacing the motor.

Pump without motor (CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20 only):

If you purchased a pump end without motor, the shaft seal has been set from factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

Pump without motor (CR, CRN 32, 45, 64, 90, 120, and 150 only):

If you purchased a pump end without motor, you must install the shaft seal. The shaft seal is protected in its own box inside the pump packing crate. To protect the shaft and bearings during shipment, a transport protector is used. Remove the transport protector prior to installation of the shaft seal. Read the seal installation instructions which are included in the pump packing.

4.4 Electrical requirements

Warning

Electrical work: All electrical work should be performed by a qualified electrician in accordance with the current national, state, and local codes and regulations.

Warning

Shock hazard: A faulty motor or faulty wiring can cause electric shock that could be fatal, whether the motor is touched directly or the current is conducted through standing water. For this reason, safe installation and operation require proper grounding of the pump to the power supply ground (earth) terminal.

In all installations, connect the above-ground metal plumbing to the power supply ground terminal as described in Article 250-80 of the National Electrical Code.

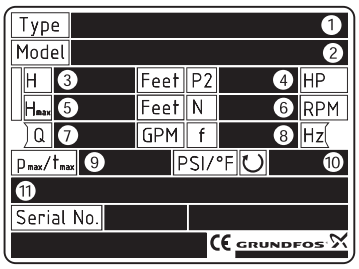
Verify the power supply to make sure that the voltage, phases and frequency match those of the pump. The proper operating voltage and other electrical information appear on the motor nameplate. These motors are designed to run on - 10 %/+ 10 % of the rated nameplate voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10 % rating, i.e., a 208 V motor should be wired according to the 208 V wiring diagram. The wiring diagram can be found on either a plate attached to the motor or on a label inside the terminal box cover.

Caution ***Do not operate the pump if voltage variations are greater than - 10 % /+ 10 %.***

CR 45-3-1 A-G-A-E-HQQE

5. Identification

5.1 Nameplate data

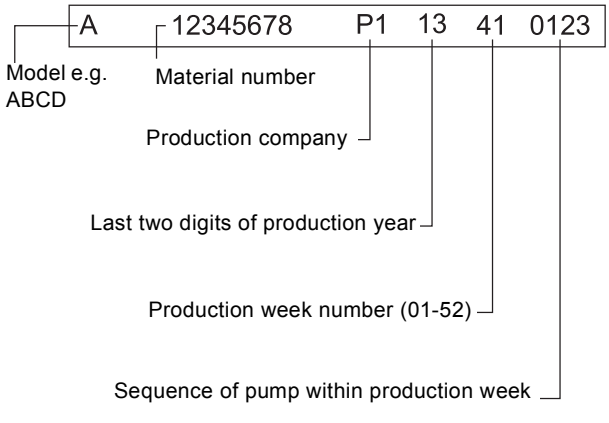


1. Type designation
2. Model, material number, production number
3. Head in feet at rated flow
4. Rated motor hp
5. Head at zero flow
6. Rated rpm
7. Rated flow
8. Rated frequency
9. Maximum pressure and maximum liquid temperature
10. Direction of rotation
11. Production country

TM04 3895 2609

Fig. 1 Example of nameplate CR, CRI, CRN, CRT

Specification of the model line in nameplates:



TM04 3904 3913

Fig. 2 Key to model line in nameplates

5.2 Type keys

5.2.1 CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20

Example	CR 3-	10	A	FG	A	E	HQQE
Type range: CR, CRI, CRN							
Rated flow rate in [m^3/h] (x 5 gpm)							
Number of impellers							
Code for pump version							
Code for pipe connection							
Code for materials							
Code for rubber parts							
Code for shaft seal							

5.2.2 CR, CRN 32, 45, 64, 90, 120, and 150

Example	CR 32-	2-	1	A	G	A	E	KUBE
Pump range: CR, CRN								
Rated flow rate in [m^3/h] (x 5 gpm)								
Number of impellers								
Number of reduced-diameter impellers								
Code for pump version								
Code for pipe connection								
Code for materials								
Code for rubber parts								
Code for shaft seal								

5.2.3 CRT 2, 4, 8, and 16

Example	CRT	16-	30	/2	A	G	A	AUUE
Pump range: CRT								
Rated flow rate in [m^3/h] (x 5gpm)								
Number of stages x 10								
Code for impellers (used only if the pump has fewer impellers than stages)								
Code for pump version								
Code for pipe connection								
Code for materials								
Code for shaft seal and rubber parts								

5.2.4 Codes

CR 45-3-1 A-G-A-E-HQQE

Example	A	-G	-A	-E	-H	QQ	E
Pump version							
A Basic version[1)]							
B Oversize motor							
E Certificate/approval							
F CR pump for high temperatures (air-cooled top assembly)							
H Horizontal version							
HS High-pressure pump with high-speed MLE motor							
I Different pressure rating							
J Pump with different max. speed							
K Pump with low NPSH							
M Magnetic drive							
N Fitted with sensor							
P Undersize motor							
R Horizontal version with bearing bracket							
SF High-pressure pump							
T Oversize motor (two flange sizes bigger)							
U NEMA version[1)]							
X Special version[2)]							
Pipe connection							
A Oval flange, Rp thread							
B Oval flange, NPT thread							
CA FlexiClamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)							
CX Triclamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)							
F DIN flange							
G ANSI flange							
J JIS flange							
N Changed diameter of ports							
P PJE coupling							
X Special version							
Materials							
A Basic version							
D Carbon-graphite filled PTFE (bearings)							
G Wetted parts, AISI 316							
GI All parts stainless steel, wetted parts, AISI 316							
I Wetted parts, AISI 304							
II All parts stainless steel, wetted parts, AISI 304							
K Bronze (bearings)							
S SiC bearings + PTFE neck rings							
X Special version							
Code for rubber parts							
E EPDM							
F FXM							
K FFKM							
V FKM							

CR 45-3-1 A-G-A-E-HQQE

Example	A	-G	-A	-E	-H	QQ	E

Shaft seal

A	O-ring seal with fixed driver
B	Rubber bellows seal
E	Cartridge seal with O-ring
H	Balanced cartridge seal with O-ring
K	Metal bellows cartridge seal
O	Double seal, back-to-back
P	Double seal, tandem
X	Special version

B	Carbon, synthetic resin-impregnated
H	Cemented tungsten carbide, embedded (hybrid)
Q	Silicon carbide
U	Cemented tungsten carbide
X	Other ceramics

E	EPDM
F	FXM
K	FFKM
V	FKM

[1] In August 2003 the NEMA version pump code was discontinued for all material numbers created by Grundfos manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or a U as the pump version code depending on the date the material number was created.

[2] If a pump incorporates more than two pump versions, the code for the pump version is X. X also indicates special pump versions not listed above.

6. Applications

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Make sure the application falls within the following limits.

Type	Application/liquid
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal liquids.
CRI/CRN	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High-pressure washdown, reverse osmosis or other high-pressure applications.
CRT	Salt water, chloride based liquids and liquids approved for titanium.

7. Operating conditions

7.1 Ambient temperature and altitude

If the ambient temperature exceeds the maximum temperature limits of the pump or the pump is installed at an altitude exceeding the altitude values in the chart below, the motor must not be fully loaded due to the risk of overheating.

Overheating may result from excessive ambient temperatures or the low density and consequently low cooling effect of the air at high altitudes. In such cases, it may be necessary to use a motor with a higher rated output (P_2).

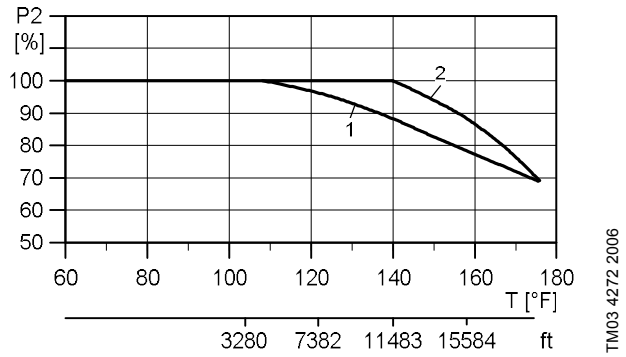


Fig. 3 Relationship between motor output (P_2) and ambient temperature/altitude

Legend

Pos.	Description
1	NEMA standard-efficiency motors
2	NEMA premium-efficiency motors

Example: From fig. 3 it appears that P_2 must be reduced to 88 % when a pump with a NEMA premium-efficiency ML motor is installed 15,584 feet above sea level. At an ambient temperature of 167 °F, P_2 of a standard-efficiency motor must be reduced to 74 % of rated output.

In cases where both the maximum temperature and the maximum altitude are exceeded, the derating factors must be multiplied. Example: 0.89 x 0.89 = 0.79.

7.2 Liquid temperatures

Pump	Liquid temperature
CR, CRI, CRN 1s, 3, 5, 10, 15, and 20	-4 - +248 °F (-20 - +120 °C)
CR, CRN 32, 45, 64, and 90*	-22 - +248 °F (-30 - +120 °C)
CR, CRN 120 and 150* (up to 60 hp)	-22 - +248 °F (-30 - +120 °C)
CR, CRN 120 and 150 (75 and 100 hp)	32-248 °F (0-120 °C)
CRT 2, 4, 8, 16	-4 - +248 °F (-20 - +120 °C)
CRN-SF	-4 - +221 °F (-15 - +105 °C)
Pumps with Cool-Top™	up to 356 °F (180 °C)

All motors are designed for continuous duty in 104 °F (40 °C) ambient air conditions. For higher ambient temperature conditions, consult Grundfos.

* We recommend xUBE shaft seals for temperatures above 200 °F. Pumps with KUHE hybrid shaft seals can only operate up to 200 °F (90 °C). Pumps with xUUE shaft seals can be operated down to -40 °F (-40 °C). ("x" is the seal type).

7.3 Minimum inlet pressures

All CR, CRI, CRN	NPSHR + 2 feet
CRN-SF	29 psi (2 bar)

7.4 Maximum inlet pressures

Pump type	Stages		Max. [psi (bar)]
	60 Hz	50 Hz	
CR, CRI, CRN 1s	2-27	2-36	145 (10)
CR, CRI, CRN 1	2-25	2-36	145 (10)
	27		217 (15)
CR, CRI, CRN 3	2-17	2-29	145 (10)
	19-25	31-36	217 (15)
CR, CRI, CRN 5	2-9	3-16	145 (10)
	10-24	18-36	217 (15)
CR, CRI, CRN 10	1-5	1-6	116 (8)
	6-17	7-22	145 (10)
CR, CRI, CRN 15	1-2	1-3	116 (8)
	3-12	4-17	145 (10)
CR, CRI, CRN 20	1	1-3	116 (8)
	2-10	4-17	145 (10)
CR, CRN 32	1-1 - 2	1-1 - 4	58 (4)
	3-2 - 6	5-2 - 10	145 (10)
	7-2 - 11-2	11-14	217 (15)
CR, CRN 45	1-1 - 1	1-1 - 2	58 (4)
	2-2 - 3	3-2 - 5	145 (10)
	4-2 - 8-1	6-2 - 13-2	217 (15)
CR, CRN 64	1-1	1-1 - 2-2	58 (4)
	1 - 2-1	2-1 - 4-2	145 (10)
	2 - 5-2	4-1 - 8-1	217 (15)
CR, CRN 90		1-1 - 1	58 (4)
	1-1 - 1	2-2 - 3-2	145 (10)
	2-2 - 4-1	3-6	217 (15)
CR, CRN 120	1-1 - 1	1 - 2-1	145 (10)
	2-2 - 3	2 - 5-1	217 (15)
	4-1 - 5-1	6-1 - 7	290 (20)
CR, CRN 150	1-1	1-1 - 1	145 (10)
	1-2	2-1 - 4-1	217 (15)
	3-2 - 4-2	5-2 - 6	290 (20)
CRT 2	2-6	2-11	145 (10)
	7-18	13-26	217 (15)
CRT 4	1-7	1-12	145 (10)
	8-16	14-22	217 (15)
CRT 8	1-16	1-20	145 (10)
CRT 16	2-10	2-16	145 (10)
CRN-SF	all	all	72 (5)*
			362 (25)**

* While pump is off or during start-up.

** During operation.

7.5 Maximum operating pressures

250 °F (194 °F for CRN-SF)

Pump type/ connection	Stages		Max. [psi (bar)]
	60 Hz	50 Hz	
CR, CRI, CRN 1s			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 1			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 3			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 5			
Oval flange	1-16	1-22	232 (16)
FGJ, PJE	1-24	1-36	362 (25)
CR, CRI 10			
Oval flange CR	1-6		145 (10)
Oval flange, CRI	1-10	1-16	232 (16)
FGJ, GJ, PJE	1-10	1-16	232 (16)
FGJ, GJ, PJE	12-17	17-22	362 (25)
CRN 10			
All	1-17	1-22	362 (25)
CR, CRI 15			
Oval flange	1-5	1-7	145 (10)
FGJ, GJ, PJE	1-8	1-10	232 (16)
FGJ, GJ, PJE	9-12	12-17	362 (25)
CRN 15			
All	1-12	1-17	362 (25)
CR, CRI 20			
Oval flange	1-5	1-7	145 (10)
FGJ, GJ, PJE	1-7	1-10	232 (16)
FGJ, GJ, PJE	8-10	12-17	362 (25)
CRN 20			
All	1-10	1-17	362 (25)
CR, CRN 32			
	1-1 - 5	1-1 - 7	232 (16)
	6-2 - 11-2	8-2 - 14	435 (30)
CR, CRN 45			
	1-1 - 4-2	1-1 - 5	232 (16)
	4-2 - 8-1	6-2 - 13-2	435 (30)
CR, CRN 64			
	1-1 - 3	1-1 - 5	232 (16)
	4-2 - 5-2	6-2 - 8-1	435 (30)
CR, CRN 90			
	1-1 - 3	1-1 - 4	232 (16)
	4-2 - 4-1	5-2 - 6	435 (30)
CR, CRN 120			
	1-1 - 3		232 (16)
	4-2 - 5-2	1-1 - 5-2	435 (30)
CR, CRN 150			
	1-1 - 3		232 (16)
	4-1 - 4-2	1-1 - 4-2	435 (30)
CRT 2	2-18	2-26	305 (21)
CRT 4	1-16	1-22	305 (21)
CRT 8	1-8	1-12	232 (16)
	10-16	14-20	362 (25)
CRT 16	1-8	1-8	232 (16)
	10-12	10-16	362 (25)

Consult Grundfos in case of other operating conditions.

8. Installation

Warning

Do not turn on the power supply until the pump is properly installed.

8.1 Pump location

Locate the pump in a dry, well-ventilated, frost-free area which is not subject to extreme variation in temperature.

Make sure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces.

The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair.

In open systems requiring suction lift, locate the pump as close to the liquid source as possible to reduce friction loss in pipes.

8.2 Foundation

Use concrete or similar foundation material to provide a secure, stable mounting base for the pump.

See table below for bolt hole center line dimensions for the various pump types.

Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported (uneven surfaces can result in pump base breakage when mounting bolts are tightened).

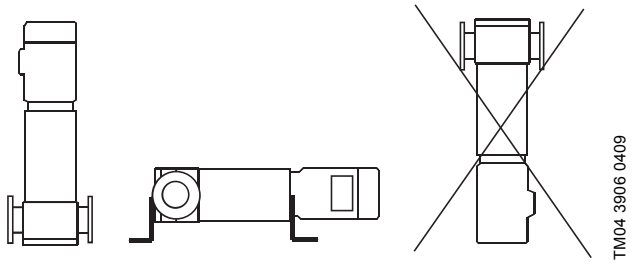


Fig. 4 Pump position

The pump can be installed vertically or horizontally. See fig. 4.

Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

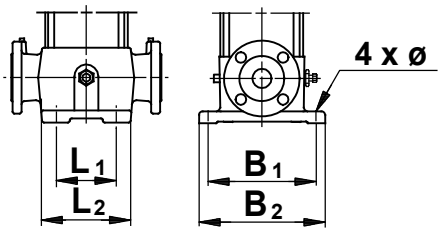
Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

Note ***Make sure the vent plug is located in the uppermost position.***

Fit isolating valves on either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.

Base and bolt hole center line dimensions



Pump type	L1		L2		B1		B2		ø	
	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]
CR 1s, 1, 3, 5	3 15/16	100	5 11/16	145	7 1/16	180	8 11/16	220	1/2	13
CRI, CRN 1s 1, 3, 5 CRT 2, 4	3 15/16	100	5 7/8	150	7 1/16	180	8 11/16	220	1/2	13
CR 10, 15, 20	5 1/8	130	6 15/16	176	8 7/16	215	10 1/16	256	9/16	13.5
CRN 10, 15, 20 CRT 8, 16	5 1/8	130	7 7/8	200	8 7/16	215	9 3/4	248	1/2	13
CR 32	6 11/16	170	8 3/4	223	9 7/16	240	11 3/4	298	9/16	14
CRN 32	6 11/16	170	8 7/8	226	9 7/16	240	11 3/4	298	9/16	14
CR 45, 64	7 1/2	190	9 3/4	248	10 1/2	266	13 1/16	331	9/16	14
CRN 45, 64	7 1/2	190	9 7/8	251	10 1/2	266	13 1/16	331	9/16	14
CR, CRN 90	7 13/16	199	10 1/4	261	11	280	13 11/16	348	9/16	14
CR, CRN 120, 150	10 13/16	275	13 9/16	344	14 15/16	380	18 9/16	472	11/16	18

8.3 Pump mounting

Warning

CR, CRI, CRN pumps are shipped with covered suction and discharge ports. Remove the covers before the pipes are connected to the pump.

8.3.1 Recommended installation torques

Pump type	Recommended foundation torque [ft-lbs]	Recommended flange torque [ft-lbs]
CR, CRI, CRN 1s/1/3/ 5 and CRT 2/4	30	37-44
CR, CRI, CRN 10/15/ 20 and CRT 8/16	37	44-52
CR, CRN 32/45/64/90/ 120/150	52	52-59

8.4 Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the suction flange). Avoid using unnecessary fittings, valves or accessory items. Use butterfly valves in the suction line only when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See fig. 5 and fig. 6. Flush piping prior to pump installation to remove loose debris.

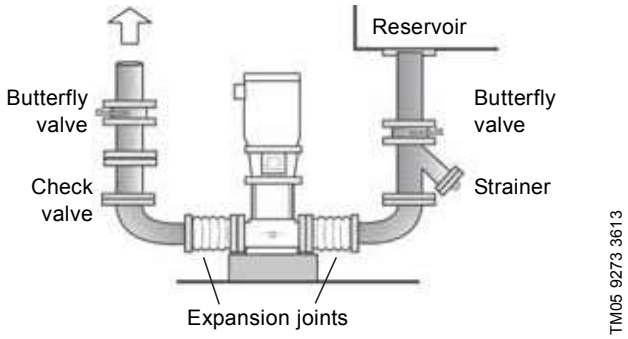


Fig. 5 Flooded suction

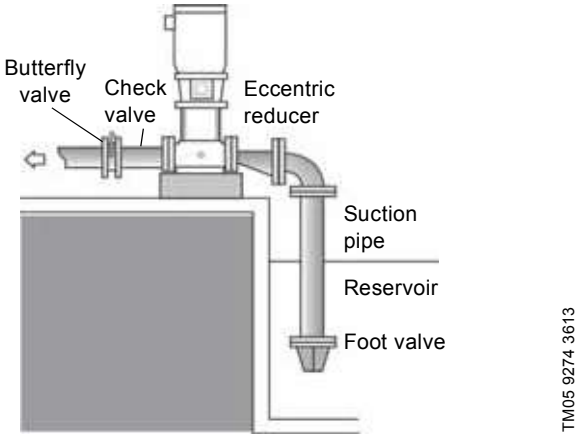


Fig. 6 Suction lift*

* The suction pipe should have a fitting on it for priming. CRN-SF pumps cannot be used for suction lift.

8.4.1 Suction pipe sizes

The following recommended suction pipe sizes are the smallest sizes which should be used with any specific CR pump type.

Verify the suction pipe size in each installation to ensure that good pipe practices are being observed and excess friction losses are not encountered.

High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

Pump type	Min. suction pipe size	
CR, CRI, CRN 1s, 1, 3; CRT 2	1"	Nominal diameter acc. to ANSI schedule 40
CR, CRI, CRN 5; CRT 4	1 - 1/4"	Nominal diameter acc. to ANSI schedule 40
CR, CRI, CRN 10, 15, 20; CRT 8, 16	2"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 32	2 - 1/2"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 45	3"	Nominal diameter acc. to ANSI schedule 40
CR, CRN64, 90	4"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 120, 150	5"	Nominal diameter acc. to ANSI schedule 40

8.5 Discharge pipe

We suggest to install a check valve and a isolating valve in the discharge pipe.

Pipe, valves and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive flow velocities and friction losses in pipes.

Caution ***The pressure rating of pipes, valves and fittings must be equal to or greater than the maximum system pressure.***

Before installing the pump, pressure check the discharge piping to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure-loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump.

According to good installation practices, clean the system thoroughly and flush it of all foreign materials and sediment prior to pump installation. Furthermore, never install the pump at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles, we recommend that a strainer or filter is used. Grundfos recommends that pressure gauges are installed on suction and discharge flanges or in pipes to monitor pump and system performance.

Warning

To avoid problems with water hammer, do not use quick-closing valves in CRN-SF applications.

8.6 Bypass

Install a bypass in the discharge pipe if there is any risk that the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure that adequate cooling and lubrication of the pump is maintained.
See *7.3 Minimum inlet pressures* for minimum flow rates.

Elbows should be at least 12" from the bypass opening to prevent erosion.

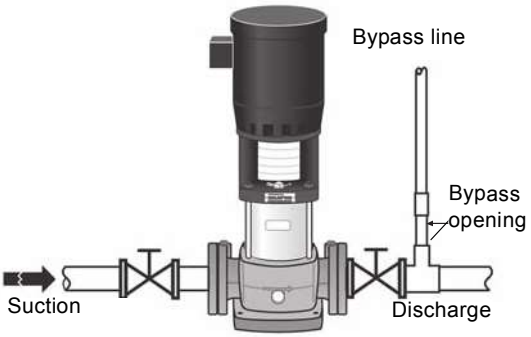


Fig. 7 Recommended bypass arrangement

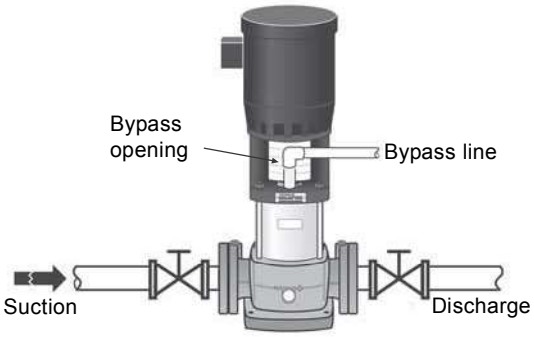


Fig. 8 Optional bypass arrangement

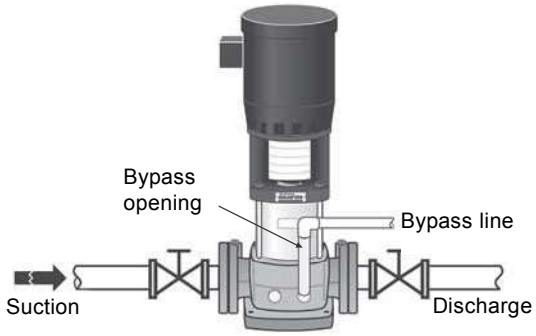
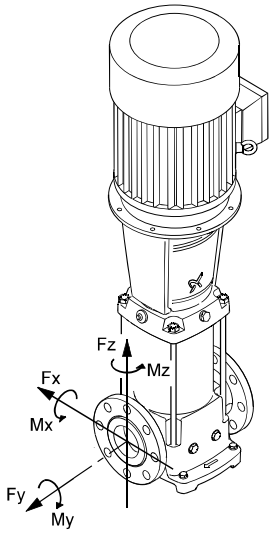


Fig. 9 Optional bypass arrangement for CR, CRN 32, 45, 64 and CR 90, 120 and 150 only

8.7 Flange forces and torques

If not all loads reach the maximum permissible value stated in the tables after fig. 10, one of these values may exceed the normal limit. Contact Grundfos for further information.



Y-direction: Direction of chamber stack
Z-direction: 90 ° from inlet/outlet
X-direction: Inlet/outlet

Fig. 10 Flange forces and torques

Flange	CR, CRI, CRN	Force [F]		
		Y-direction [lb]	Z-direction [lb]	X-direction [lb]
1 1/4"	1s to 5	171	263	175
2"	10, 15 and 20	303	371	337
2 1/2"	32	382	466	422
3"	45	461	562	506
4"	64 and 90	607	753	674
5", 6"	120 and 150	607	753	674

Flange	CR, CRI, CRN	Torque [M]		
		Y-direction [ft-lb]	Z-direction [ft-lb]	X-direction [ft-lb]
1 1/4"	1s to 5	605	715	900
2"	10, 15 and 20	738	848	1,033
2 1/2"	32	793	904	1,106
3"	45	848	959	1,180
4"	64 and 90	922	1,069	1,291
5", 6"	120 and 150	922	1,069	1,291

8.8 Minimum continuous duty flow rates [gpm]

Pump type	min. °F to 176 °F (min. °C to 80 °C)	at 210 °F (at 99 °C)	at 248 °F (at 120 °C)	at 356 °F (at 180 °C)
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CR, CRN 90	44	66	110	110*
CR, CRN 120	60	90	N/A	N/A
CR, CRN 150	75	115	N/A	N/A
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CRT 8	4.0	6.0	10	N/A
CRT 16	8.0	12	20	N/A

* Grundfos Cool-Top® is only available in the following pump types:

Pump type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64	CR 90
Standard (CR)								●	●	●	●
I version (CRI)	●	●	●	●	●	●	●				
N version (CRN)	●	●	●	●	●	●	●	●	●	●	●

8.9 Check valves

A check valve may be required on the discharge side of the pump to prevent the pump inlet pressure from being exceeded.

When a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the discharge side of the pump will "find" its way back to the inlet of the pump.

This is especially critical for CRN-SF applications because of the very high discharge pressures involved. As a result, most CRN-SF installations require a check valve on the discharge piping.

8.10 Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation.

When the flow is stopped, the power to the pump is transferred to the pumped liquid as heat, causing a temperature rise in the liquid.

The result is risk of overheating and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. See the following temperature rise table.

Pump type	Time for temperature rise of 18 °F (10 °C)	
	Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64, 90, 120, 150	60	1.0

Conditions/reservations

The listed times are subject to the following conditions/ reservations:

- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat capacity of 1.0 $^{Btu}/_{lb.}$ °F (4.18 $^{kJ}/_{kg}$ °C).
- Pump parts (chambers, impellers and shaft) have the same heat capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise.

The maximum temperature must not exceed the pump maximum temperature rating.

8.11 Electrical connection

Warning

The safe operation of this pump requires that it is grounded in accordance with the National Electrical Code and local codes and regulations. Connect the ground conductor to the grounding screw in the terminal box and then to the ACCEPTABLE grounding point. All electrical work must be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code and local codes and regulations.

8.12 Motors

Grundfos CR pumps are supplied with heavy-duty, 2-pole (3600 rpm), ODP (open drip-proof) or TEFC (totally enclosed fan cooled), NEMA C frame motors selected to our rigid specifications.

Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis.

CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing.

If you replace the pump, but keep a motor previously used on another CR pump, be sure to read *12. Maintaining the motor* for proper adjustment of the coupling height.

8.13 Position of terminal box

The motor terminal box can be turned to any of four positions in steps of 90 °.

To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the coupling. Turn the motor to the desired position; replace and securely tighten the four bolts. See fig. 11.

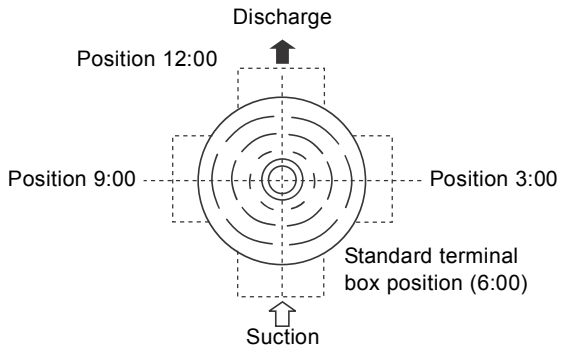


Fig. 11 Motor terminal box positions (top view)

8.14 Field wiring

Lead sizes should be based on the current carrying properties of conductors required by the latest edition of the National Electrical Code or local regulations. Direct-on-line (DOL) starting is approved due to the extremely short run-up time of the motor and the low moment of inertia of the pump and motor. If DOL starting is not acceptable and reduced starting current is required, use an auto transformer, resistance starter or soft starter. We suggest to use a fused disconnect for each pump in case standby pumps are installed.

8.15 Motor protection

8.15.1 Single-phase motors

All CR pumps with single phase motors, except 10 hp, are equipped with multi-voltage, squirrel cage induction motors which include built-in thermal protection.

8.15.2 Three-phase motors

CR pumps with three-phase motors must be used with the proper size and type of motor-protective circuit breaker to ensure the motor is protected against damage from low voltage, phase failure, current unbalance and overloads.

Use a properly sized circuit breaker with manual reset and ambient-temperature compensated extra-quick trip in all three phases. The overload protection should be set and adjusted to the full-load current rating of the motor. Under no circumstances should the overload protection be set to a higher value than the full-load current shown on the motor nameplate. This will void the warranty.

Set overload protection for auto transformers and resistance starters in accordance with the recommendations of the manufacturer.

Three-phase MLE motors (CRE-pumps) require only fuses as circuit breaker. They do not require a motor-protective circuit breaker. Check for phase unbalance (worksheet is provided. See section *18. Worksheet for three-phase motors*).

Caution ***Standard allowable phase unbalance is 5 %.***

8.15.3 CRN-SF

The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), use a control device to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops. See CRN-SF start-up timeline below.

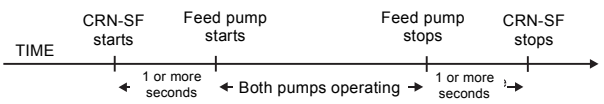


Fig. 12 CRN-SF start-up

9. Commissioning

9.1 Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolating valve(s) and open the priming plug on the pump head. See fig. 13, fig. 14, and fig. 15.

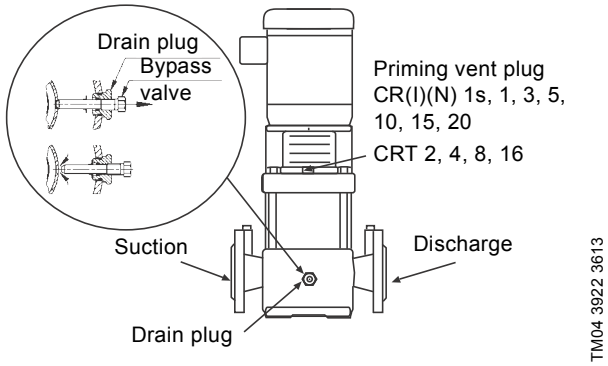


Fig. 13 Position of plugs and bypass valve

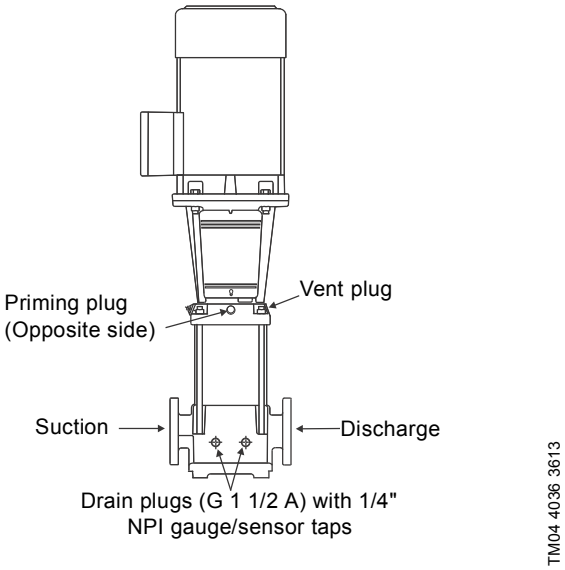


Fig. 14 Position of plugs CR, CRN 32, 45, 64, 90, 120, 150

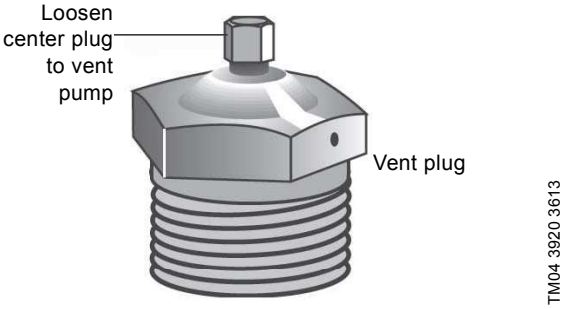


Fig. 15 Vent plug

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled with liquid and vented before starting the pump.

1. Close the discharge isolating valve and remove the priming plug.
2. Pour water through the priming hole until the suction pipe and pump are completely filled with liquid. If the suction pipe does not slope downwards away from the pump, the air must be purged while priming the pump.
3. Replace the priming plug and tighten securely.

9.2 Startup

1. Gradually open the isolating valve in the suction line until a steady stream of airless water runs out of the priming hole.
2. Close the plug and tighten securely.
3. Completely open the isolating valves.

For pumps with Cool-Top®, see section *16. Startup of pump with air-cooled top (Cool-Top®)*.

Follow these steps:

1. Switch off the power supply.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to make sure it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch on the power and observe the direction of rotation. When viewed from above, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch off the power supply.
7. On three-phase motors, interchange any two phases of the power supply.
   On single-phase motors, see wiring diagram on the nameplate. Change wiring as required.
8. Switch on the power again and check for proper direction of rotation. Once direction of rotation has been verified, switch off the power again. Do not attempt to reinstall the coupling guards while the motor is on. Replace the coupling guard if the direction of rotation is correct. When the guards are in place, the power can be switched on again.

Note

For CR, CRI, CRN 1s to 5 it is advisable to open the bypass valve during start-up. See fig. 13. The bypass valve connects the suction and discharge sides of the pump, thus making the filling procedure easier. Close the bypass valve when operation is stable.

Caution

Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.

Do not start the pump before priming or venting the pump. See fig. 15. Never let the pump run dry.

10. Operation

10.1 Operating parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors may require periodic lubrication as described in section *12. Maintaining the motor*.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient liquid to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

10.2 Pump cycling

Pump cycling should be checked to ensure the pump is not starting more often than the following max. starts per hour:

Grundfos ML motors:

- 200 times per hour on 1/3 to 5 hp models
- 100 times per hour on 7 1/2 to 15 hp models
- 40 times per hour on 20 to 30 hp models.

Baldor motors:

- 20 times per hour on 1/3 to 5 hp models
- 15 times per hour on 7 1/2 to 15 hp models
- 10 times per hour on 20 to 100 hp models.

Rapid cycling is a major cause of premature motor failure due to overheating of the motor. If necessary, adjust controller to reduce the frequency of starts and stops.

10.3 Boiler feed installations

If the pump is used as a boiler feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication. See section *7.3 Minimum inlet pressures*.

10.4 Frost protection

If the pump is installed in an area where frost could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolating valves, remove the priming plug and drain plug at the base of the pump. Do not refit the plugs until the pump is to be used again. Always replace the drain plug with the original or an exact replacement. Do not replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.

11. Maintaining the pump

Depending on the conditions and operating time, make the following checks at regular intervals:

- Check that the pump meets the required performance and is operating smoothly and quietly.
- Check that there are no leaks, particularly at the shaft seal.
- Check that the motor is not overheating.
- Remove and clean all strainers or filters in the system.
- Check that the tripping function of the motor overload protection works.
- Check the operation of all controls.
- If the pump is not operated for unusually long periods, maintain the pump in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
- In severe-duty applications, pump life may be extended by performing one of the following actions:
  - Drain the pump after each use.
  - Flush the pump with water or other liquid that is compatible with the pump materials and process liquid.
  - Disassemble the pump and thoroughly rinse or wash components in contact with the pumped liquid with water or other liquid that is compatible with the pump materials and process liquid.

If the pump fails to operate or there is a loss of performance, see to *section 17. Diagnosing specific problems*.

12. Maintaining the motor

Warning

Before starting work on the motor, make sure that all power supplies to the motor have been switched off and that they cannot be accidentally switched on. Electric shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation, and maintenance of this equipment.

12.1 Motor inspection

Inspect the motor approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear.

Go through the following steps during each inspection:

1. Check that the motor is clean. Check that the interior and exterior of the motor are free of dirt, oil, grease, water, etc. Oily residue, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an ohmmeter periodically to ensure that the winding insulation is OK. Record the ohmmeter readings, and immediately investigate any significant drop in insulation resistance.
3. Check all electrical connections to be sure that they are tightened securely.

12.2 Motor lubrication

Electric motors are pre-lubricated from factory and do not require additional lubrication at start-up. Motors without external grease zerks have sealed bearings that cannot be re-lubricated.
Motors with grease zerks should only be lubricated with approved types of grease. Do not over-grease the bearings. Over-greasing will cause increased bearing heat and can result in bearing or motor failure. Do not mix oil-based grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time.
The lubricating ability of a grease depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions.

Good results can be obtained if the following recommendations are used in your maintenance program. It should also be noted that multistage pumps, pumps running to the left of the performance curve, and certain pump ranges may have higher thrust loads. Pumps with high thrust loads should be greased according to the next service interval level.

Warning

The grease outlet plug MUST be removed before adding new grease.

12.3 Recommended lubricant

Severity of duty	Ambient temperature (max.)	Environment	Approved types of grease
Standard	104 °F (40 °C)	Clean, little corrosion	Grundfos ML motors are greased for life, or the grease type will be stated on the nameplate. Baldor motors are greased with Polyrex EM (Exxon Mobile).
Severe	122 °F (50 °C)	Moderate dirt, corrosion	
Extreme	> 122 °F (50 °C) or class H insulation	Severe dirt, abrasive dust, corrosion	

12.4 Lubricating chart (for motors with grease zerks)

New motors that have been stored for a year or more should be regreased according to the following table:

NEMA (IEC) frame size	Service intervals [hours]			Weight of grease [oz (grams)]	Volume of grease [in^3 (teaspoons)]
	Standard duty	Severe duty	Extreme duty		
Up to and incl. 210 (132)	5500	2750	550	0.30 (8.4)	0.6 (2)
Over 210 up to and incl. 280 (180)	3600	1800	360	0.61 (17.4)	1.2 (3.9)
Over 280 up to and incl. 360 (225)	2200	1100	220	0.81 (23.1)	1.5 (5.2)
Over 360 (225)	2200	1100	220	2.12 (60.0)	4.1 (13.4)

12.5 Lubricating procedure

Caution

Keep grease free from dirt to avoid damage to motor bearings. If the environment is extremely dirty, contact Grundfos, the motor manufacturer, or an authorized service center for additional information.

Do not mix dissimilar types of grease.

1. Clean all grease zerks. If the motor does not have grease zerks, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease. If the motor is stopped, add the recommended amount of grease. If the motor is to be lubricated while running, add a slightly greater quantity of grease.
3. Add grease SLOWLY taking approximately one minute until new grease appears at the shaft hole in the flange or grease outlet plug. Never add more than 1 1/2 times the amount of grease shown in the lubricating chart.

Note

If new grease does not appear at the shaft hole or grease outlet, the outlet passage may be blocked. Contact Grundfos service center or certified motor shop.

4. Let motors equipped with a grease outlet plug run for 20 minutes before replacing the plug.

13. Replacing the motor

Caution

Motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

If the motor is damaged due to bearing failure, burning or electrical failure, observe the following instructions as to how to remove the motor and how to mount the replacement motor.

Warning

Before starting work on the motor, make sure that the mains switch has been switched off. It must be ensured that the power supply cannot be accidentally switched on.

13.1 Disassembly

Proceed as follows:

1. Disconnect the power supply leads from the motor. Remove the coupling guards.

Note

For CR 1s, 1, 3, 5, 10, 15, and 20: Do not loosen the three hexagon socket head cap screws securing the shaft seal.

2. Use the proper metric hexagon key to loosen the four cap screws in the coupling. Remove coupling halves completely. On CR 1s-CR 20, the shaft pin can be left in the pump shaft. CR, CRN 32, 45, 64, 90, 120, and 150 do not have a shaft pin.
3. Use the correct size spanner to loosen and remove the four mounting bolts joining motor and pump.
4. Lift the motor straight up until the shaft has cleared the motor stool.

13.2 Assembly

Proceed as follows:

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump mounting flanges. The motor and shaft must be clean of all oil or grease and other contaminants where the coupling attaches. Place the motor on top of the pump.
3. Turn the terminal box to the desired position by rotating the motor.
4. Insert the four mounting bolts, then tighten diagonally and evenly:
   – for 3/8" bolts (1/2 - 2 hp), torque = 17 ft-lb
   – for 1/2" bolts (3 - 40 hp), torque = 30 ft-lb
   – for 5/8" bolts (50 - 100 hp), torque = 59 ft-lb
   – follow instructions for particular pump model in sections *13.2.2 CR 1s, 1, 3, and 5* to *13.2.5 CR, CRN 32, 45, 64, 90, 120, and 150*.

13.2.1 Torque specifications

Torque specifications for CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20 CRT 2, 4, 8, and 16

Coupling screw size	Minimum torque
M6	10 ft-lb
M8	23 ft-lb
M10	46 ft-lb

13.2.2 CR 1s, 1, 3, and 5

1. Insert shaft pin into shaft hole.
2. Mount the coupling halves onto shaft and shaft pin.
3. Fit the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft keyway is centered in the coupling half as shown in fig. 16.
4. Tighten the screws to the correct torque. See section *13.2.1 Torque specifications*.

13.2.3 CR 10, 15 and 20

1. Insert shaft pin into shaft hole.
2. Insert plastic shaft seal spacer beneath shaft seal collar.
3. Mount the coupling halves onto shaft and shaft pin.
4. Fit the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft keyway is centered in the coupling half as shown in fig. 16.
5. Tighten the screws to the correct torque. See section *13.2.1 Torque specifications*.
6. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

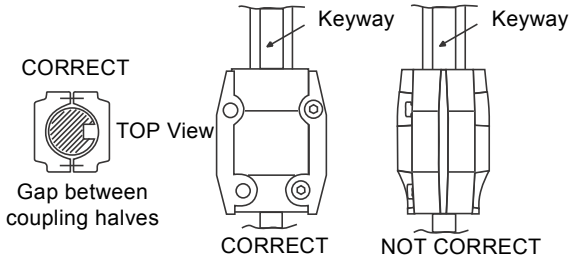


Fig. 16 Coupling adjustment all CR, CRI, CRN, CRT

13.2.4 CRT 2, 4, 8 and 16

1. Mount coupling halves. Make sure the shaft pin is located in the pump shaft.
2. Put the cap screws loosely back into the coupling halves.
3. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully raising the coupling to its highest point. See fig. 17.

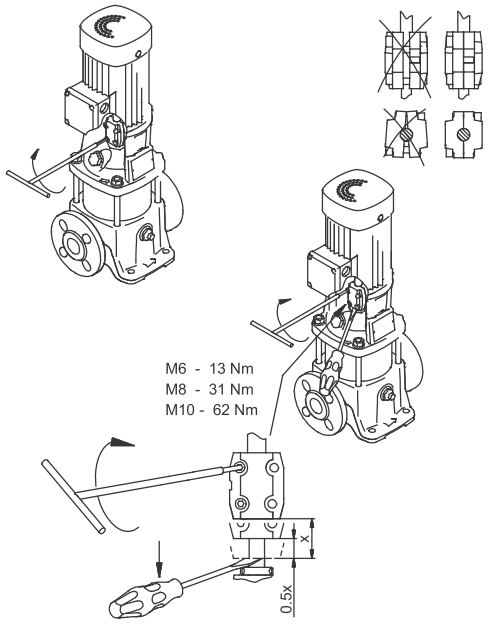


Fig. 17 Coupling adjustment CRT 2, 4, 8, and 16

Note ***The shaft can only be raised approximately 0.20 inches (5 mm).***

4. Now lower the shaft halfway back the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling gap equal on both sides. When the screws are tight enough to keep the coupling in place, then cross-tighten the screws.
   - Note the clearance below the coupling.
   - Raise the coupling as far as it will go.
   - Lower it halfway back down (1/2 the distance you just raised it).
   - Tighten screws (see torque specifications).

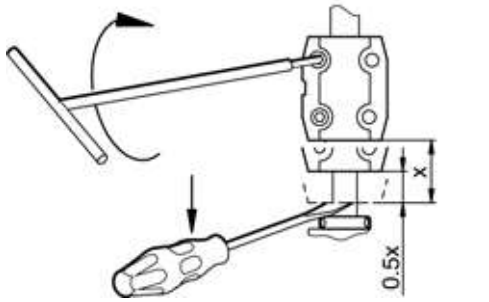


Fig. 18 Coupling adjustment clearance CRT 2, 4, 8, and 16

13.2.5 CR, CRN 32, 45, 64, 90, 120, and 150

1. Make sure pump shaft is all the way down. Tighten the set screws on the mechanical shaft seal.
2. Place the plastic adjusting fork under the cartridge seal collar. See fig. 19.

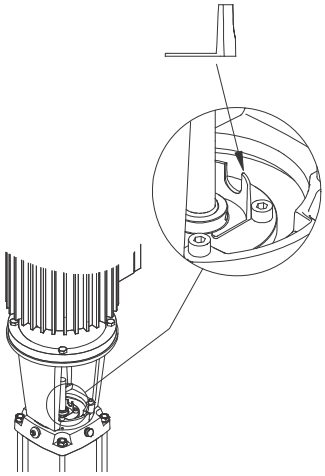


Fig. 19 Coupling adjustment CR, CRN 32, 45, 64, 90, 120, and 150

3. Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the coupling chamber. See fig. 20.

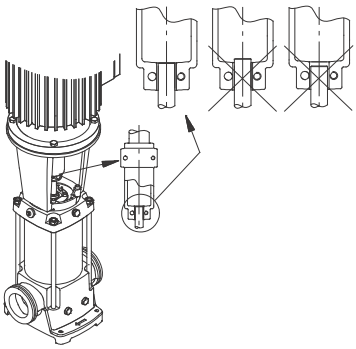


Fig. 20 Coupling adjustment, CR, CRN 32, 45, 64, 90, 120, and 150

Caution ***To avoid damaging the coupling halves, ensure that the motor shaft keyway is centered in the coupling half as shown in fig. 16.***

4. Lubricate the coupling screws with an anti-seize, lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling gap equal on both sides and the motor shaft keyway centered in the coupling half as shown in fig. 16. When the screws are tight enough to keep the coupling in place, then cross-tighten the screws.
5. Tighten coupling screws to 62 ft-lbs (75 and 100 hp motors to 74 ft-lbs). Remove the adjusting fork from under the cartridge seal collar and replace it to the storage location. See fig. 21.

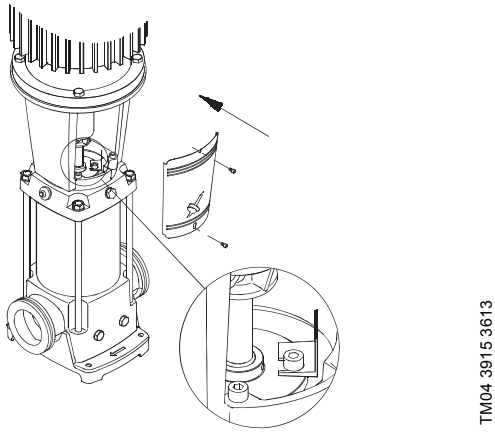


Fig. 21 Adjusting fork storage CR, CRN 32, 45, 64, 90, 120, and 150

6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Make sure the pump shaft can be rotated by hand. If the shaft cannot be rotated or it jams, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply leads to the motor.
10. Check the direction of rotation by bump-starting the motor. Direction of rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Switch off the power, then mount the coupling guards. When the coupling guards have been mounted, the power can be switched on again.

14. Parts list

Grundfos offers an extensive parts list for each CR pump model. A parts list typically covers the following items:

- a diagram of pump parts which we recommend to have on hand for future maintenance
- a list of prepacked service kits covering the pump components most likely to be exposed to wear over time
- complete chamber stacks needed to replace the rotating assembly of each model.

These parts lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos CR Service Manuals.

TM05 9272 3613

Fig. 22 Prepacked chamber stack kits

TM04 3916 1609

Fig. 23 Prepacked flange kits

14.1 Spare parts

Grundfos offers an extensive list of spare parts for CR pumps. For a current list of these parts, see Grundfos All Product Spare Parts/Service Kits Price List, part number L-SK-SL-002.

15. Preliminary electrical tests

Warning

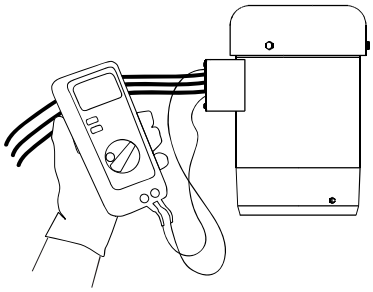
When working with electrical circuits, use caution to avoid electrical shock. It is recommended that rubber gloves and boots be worn, and metal terminal boxes and motors are grounded before any work is done. For your protection, always disconnect the pump from its power source before handling.

15.1 Supply voltage

15.1.1 How to measure the supply voltage

Use a voltmeter (set to the proper scale) to measure the voltage at the pump terminal box or starter. On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

– Power leads L1 and L2
– Power leads L2 and L3
– Power leads L3 and L1.



TM04 3911 2609

Fig. 24 Measuring supply voltage

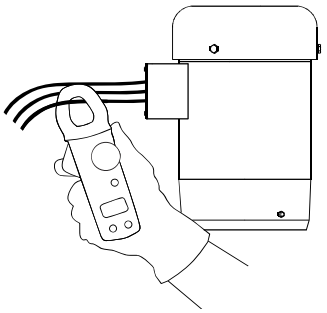
15.1.2 Meaning of supply voltage measurement

When the motor is under load, the voltage should be within + 10 %/- 10 % of the nameplate voltage. Larger voltage variation may cause winding damage. Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected. If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

15.2 Current

15.2.1 How to measure the current

Use an ammeter (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information. Current should be measured when the pump is operating at constant discharge pressure.



TM04 3908 2609

Fig. 25 Measuring current

15.2.2 Meaning of current measurement

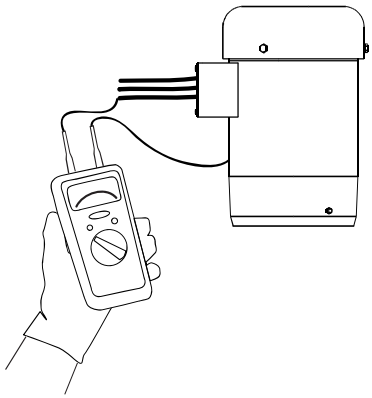
If the amp draw exceeds the listed service factor amps (SFA) or if the current unbalance is greater than 5 % between each leg on three-phase units, check for the following faults:

Fault	Remedy
Burned contacts in the motor-protective circuit breaker.	Replace contacts.
Loose terminals in motor-protective circuit breaker or terminal box or possibly defective lead.	Tighten terminals or replace lead.
Too high or too low supply voltage.	Reestablish correct supply voltage.
Motor windings are short-circuited or grounded. (Check winding and insulation resistances).	Remove cause of short circuit or grounding.
Pump is damaged causing motor overload.	Replace defective pump parts.

15.3 Insulation resistance

15.3.1 How to measure the insulation resistance

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohmmeter or megohmmeter, set the scale selector to R x 100K and zero-adjust the meter.
Measure and record the resistance between each of the terminals and ground.



TM04 3907 2609

Fig. 26 Measuring insulation resistance

15.3.2 Meaning of insulation resistance measurement

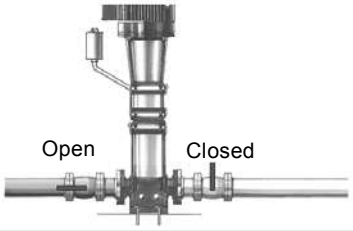
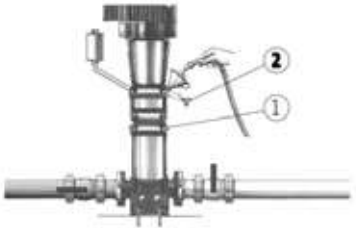
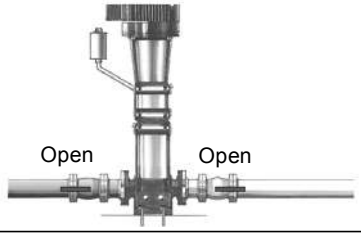
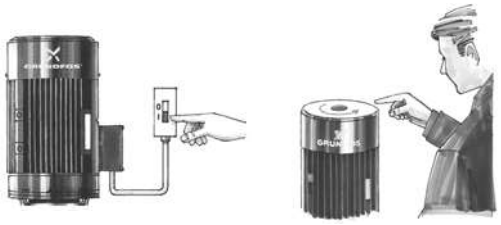
Motors of all hp, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, the motor should be repaired or replaced.

16. Startup of pump with air-cooled top (Cool-Top®)

Caution ***Do not start the pump until it has been filled with liquid and vented.***

Warning

Pay attention to the direction of the vent hole and ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components. In hot-liquid installations, pay special attention to the risk of injury caused by scalding hot liquid. We recommend you to connect a drain pipe to the 1/2" air vent in order to lead the hot water/steam to a safe place.

Step		Action
1	 TM02 4151 5001	The air-cooled top should only be started up with cold liquid. Close the isolating valve on the discharge side and open the isolating valve on the suction side of the pump.
2	 TM02 4153 1503	Remove the priming plug from the air-cooled chamber (pos. 2) and slowly fill the chamber with liquid. When the chamber is completely filled with liquid, replace the priming plug and tighten securely.
3	 TM02 5907 1503	Open the isolating valve on the discharge side of the pump. The valve may have to be partially closed when the pump is started if there is no counter pressure (i.e. boiler not up to pressure).
4	 TM01 1406 3702 - TM01 1405 4497	Start the pump and check the direction of rotation. See the correct direction of rotation of the pump on the motor fan cover. If the direction of rotation is wrong, interchange any two of the incoming power supply leads. After 3 to 5 minutes, the air vent has been filled with liquid. Note ***During start-up of a cold pump with hot liquid, it is normal that a few drops of liquid are leaking from the sleeve.***

17. Diagnosing specific problems

Warning

Before removing the terminal box cover and before removing/dismantling the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

Problem	Possible cause	Remedy
1. The pump does not run.	a) No power to motor.	Check voltage to motor terminal box. If no voltage to motor, check starter panel for tripped circuits and reset circuits.
	b) Fuses blown or circuit breaker tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	c) Motor starter overload protection burned or tripped out.	Check for voltage on line and load side of starter. Replace or reset burned motor protection. Inspect starter for other damage. If protection trips again, check the supply voltage and starter holding coil.
	d) Starter does not energize.	Energize control circuit and check for voltage to the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for short circuits. Replace bad coil.
	e) Defective control devices.	Check that all safety and pressure switches function correctly. Inspect contacts in control devices. Replace worn or defective parts or control devices.
	f) Motor is defective.	Turn off power and disconnect wiring. Measure the lead-to-lead resistances with ohmmeter (RX-1). Measure lead-to-ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace it.
	g) Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (h). Replace capacitor if defective.
	h) Pump is blocked or seized.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair the pump.

Problem	Possible cause	Remedy
2. The pump runs but at reduced performance or does not deliver water.	a) Wrong direction of rotation.	Check wiring for proper connections. Correct wiring.
	b) Pump is not primed or is air-bound.	Turn pump off, close isolation valve(s) and remove priming plug. Check liquid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.
	c) Strainers, check or foot valves are clogged.	Remove strainer, screen or check valve and inspect. Clean and replace. Reprime pump.
	d) Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	e) Suction and/or discharge pipes leaking. (Pump spins backwards when turned off)	Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	f) Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in psi) to head (in feet): (Measured psi x 2.31 ft/psi = ___ ft). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	g) Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.
	h) Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	i) Improper coupling setting.	Check/reset the coupling. See page 18.
3. Pump cycles too much	a) Pressure switch is not properly adjusted or is defective.	Check that pressure switch is set and functions correctly. Check voltage across closed contacts. Readjust switch or replace if defective.
	b) Level control is not properly adjusted or is defective.	Check that level control is set and functions correctly. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	c) Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leaks. Check tank and piping for leaks with soap and water solution. Check air-to-water volume. Repair as necessary.
	d) Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump performance. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	e) Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert psi to feet (Measured psi x 2.31 ft/psi = ____ ft) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.

Problem	Possible cause	Remedy
4. Fuses blow or circuit breakers or overload relays trip	a) Tank is too small.	Check voltage at starter panel and motor. If voltage varies more than - 10 %/+ 10 %, contact power company. Check wire sizing.
	b) Motor overload protection set too low.	Cycle pump and measure amperage. Increase size of overload protection or adjust trip setting to maximum motor nameplate (full load) current.
	c) Three-phased current is imbalanced.	Check current draw on each lead to the motor. Must be within - 5 %/+ 5 %. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	d) Motor short-circuited or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohmmeter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	e) Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wires.
	f) Pump is blocked or seized.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair the pump.
	g) Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace capacitor if defective.
	h) Motor overload protection devices at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near overload protection devices and motor. Record these values. If ambient temperature at motor is lower than at overload protection devices, especially where temperature at overload protection devices is above 104 °F (40 °C), replace standard protection devices with ambient-compensated protection devices.

18. Worksheet for three-phase motors

Below is a worksheet for calculating current unbalance on a three-phase hookup. Use the calculations below as a guide.

Note

Current unbalance should not exceed 5 % at service factor load or 10 % at rated input load. If the unbalance cannot be corrected by rolling the leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source. However, if the reading farthest from the averages moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider if the cause can be a damaged cable, an untight cable splice, a poor connection, or a faulty motor winding.

Explanation and examples

Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup numbers 1, 2, and 3.

Hookup 1

T1 = 51 amps
T2 = 46 amps
T3 = 53 amps
TOTAL = 150

Divide the total by three to obtain the average.

Hookup 1

50 amps
3 | 150 amps

Calculate the greatest current difference from the average.

Hookup 1

50 amps
— 46 amps
4 amps

Divide this difference by the average to obtain the percentage of the unbalance.
In this case, the current unbalance for **Hookup 1** is 8 %.

Hookup 1

.08 or 8 %
50 | 4.00 amps

Blank worksheet

Hookup 1	Hookup 2	Hookup 3
L_1 to T_1 = ___ amps	L_1 to T_3 = ___ amps	L_1 to T_2 = ___ amps
L_2 to T_2 = ___ amps	L_2 to T_1 = ___ amps	L_2 to T_3 = ___ amps
L_3 to T_3 = ___ amps	L_3 to T_2 = ___ amps	L_3 to T_1 = ___ amps
TOTAL = ___ amps	TOTAL = ___ amps	TOTAL = ___ amps

Hookup 1	Hookup 2	Hookup 3
___ amps	___ amps	___ amps
3 | ___ amps	3 | ___ amps	3 | ___ amps

Hookup 1	Hookup 2	Hookup 3
___ amps	___ amps	___ amps
___ amps	___ amps	___ amps
___ amps	___ amps	___ amps

Hookup 1	Hookup 2	Hookup 3
___ or ___ %	___ or ___ %	___ or ___ %
___ | ___ amps	___ | ___ amps	___ | ___ amps

19. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

L-CR-TL-001

98419736 0114

ECM: 1122180

CUE

Installation and operating instructions

Alternate Option: CUE is the Grundfos VFD that will be panel mounted

Original installation and operating instructions

These installation and operating instructions describe the Grundfos CUE frequency converter.

Sections 1-7 provide the information necessary to be able to install and start up the products in a safe way.

Sections 8-14 provide important information about operating the setup, as well as information about fault finding and disposal of the product.

CONTENTS

Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Limited warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

2. General information

2.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

2.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

2.3 References

Technical documentation for Grundfos CUE:

- The manual contains all information required for putting CUE into operation.
- The data booklet contains all technical information about the construction and applications of CUE.
- The service instructions contain all required instructions for dismantling and repairing the frequency converter.

Technical documentation is available on Grundfos Product Center at www.grundfos.com.

If you have any questions, please contact the nearest Grundfos company or service workshop.

3. Product introduction

3.1 Product description

CUE is a series of external frequency converters especially designed for pumps.

With the startup guide in CUE, the installer can quickly set central parameters and put CUE into operation.

Connected to a sensor or an external control signal, CUE will quickly adapt the pump speed to the actual demand.

The operating panel displays any alarms or warnings.

If the pump speed exceeds the rated speed, the pump will be overloaded.

3.2 Intended use

CUE frequency converters can be used in both new and existing installations. Local operation is performed via the operating panel which has a graphic display showing the menu structure. The menu structure uses the same system as Grundfos E-pumps.

Remote operation is performed via external signals, for instance via digital inputs or GENIbus.

3.3 Applications

The CUE series and Grundfos standard pumps are a supplement to the Grundfos E-pumps range with integrated frequency converter.

A CUE solution offers the same E-pump functionality in these cases:

- in mains voltage or power ranges not covered by the E-pump range
- in applications where an integrated frequency converter is not desirable or permissible.

3.4 Identification

3.4.1 Nameplate

CUE can be identified by means of the nameplate. An example is shown below.

TM04 3272 3808

Fig. 1 Example of nameplate

Text	Description
T/C:	CUE (product name) 202P1M2... (internal code)
Prod. no:	Product number: 12345678
S/N:	Serial number: 123456G234 The last three digits indicate the production date: 23 is the week, and 4 is the year 2004.
1.5 kW (2 hp)	Typical shaft power on the motor
IN:	Supply voltage, frequency and maximum input current
OUT:	Motor voltage, frequency and maximum output current. The maximum output frequency usually depends on the pump type.
CHASSIS/IP20	Enclosure class
Tamb.	Maximum ambient temperature

3.4.2 Packaging label

CUE can also be identified by means of the label on the packaging.

4. Receiving the product

WARNING

Crushing of feet

Death or serious personal injury

- Use safety shoes during transport and avoid stacking the boxes.

CAUTION

Heavy lifting

Minor or moderate personal injury

- Use proper lifting equipment when handling the product.
- Follow local regulations.

4.1 Transporting the product

To prevent damage during the transport, CUE must only be unpacked at the installation site.

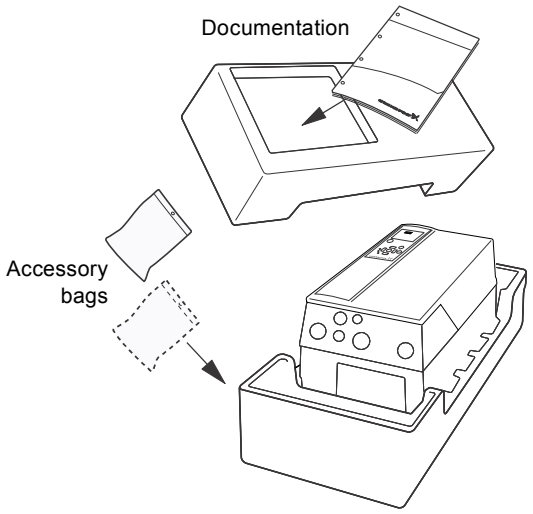
4.2 Inspecting the product

Check on receipt that the packaging is intact and the unit is complete. In case of damage during transport, contact the transport company to complain.

Note that CUE is delivered in packaging which is not suitable for outdoor storage.

4.3 Scope of delivery

The packaging contains one or more accessory bags, documentation and the unit itself. See fig. 2.

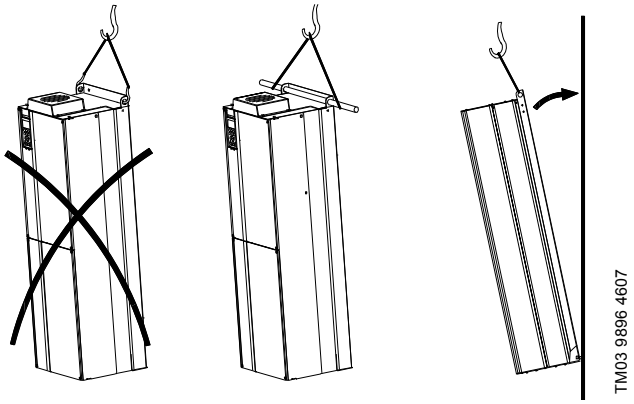


TM03 8857 2607

Fig. 2 CUE packaging

4.3.1 Lifting CUE

Always lift the product using the lifting holes. Use a bar to avoid bending the lifting holes. See fig. 3.



TM03 9896 4607

Fig. 3 Recommended lifting method

5. Installation requirements

Any installation, maintenance and inspection must be carried out by trained persons.

WARNING

Sharp element

Death or serious personal injury

- Use safety knives and protective gloves when unpacking the product.

WARNING

Heavy lifting

Death or serious personal injury

- Use proper lifting equipment when handling the product.
- Follow local regulations.

WARNING

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off at least for as long as stated below and that it cannot be accidentally switched on.
- Touching the electrical parts may be fatal, even after CUE has been switched off.

Voltage	Min. waiting time		
	4 minutes	15 minutes	20 minutes
200-240 V	0.75 - 3.7 kW (1-5 hp)	5.5 - 45 kW (7.5 - 60 hp)	
380-500 V	0.55 - 7.5 kW (0.75 - 10 hp)	11-90 kW (15-125 hp)	110-250 kW (150-350 hp)
525-600 V	0.75 - 7.5 kW (1-10 hp)		
525-690 V			11-250 kW (15-350 hp)

Only wait for a shorter period of time if stated on the nameplate of the product in question.

Safety regulations

- The OFF button of the operating panel does not disconnect CUE from the power supply and must therefore not be used as a safety switch.
- CUE must be earthed correctly and protected against indirect contact according to local regulations.
- The leakage current to protective earth exceeds 3.5 mA.
- Enclosure class IP20/21 must not be installed freely accessible, but only in a panel.
- Enclosure class IP54/55 must not be installed outdoors without additional protection against weather conditions and the sun.
- The STO function does not disconnect CUE from the power supply and must therefore not be used as a safety switch.
- The STO function does not prevent unwanted movement from external forces on the motor, for example, back pressure, and the motor shaft must be covered.

Always observe local regulations concerning cable cross-section, short-circuit protection and overcurrent protection.

The general safety necessitates special considerations as to these aspects:

- fuses and switches for overcurrent and short-circuit protection
- selection of cables (mains current, motor, load distribution and relay)
- net configuration (IT, TN, earthing)
- safety on connecting inputs and outputs (PELV).

5.1 IT mains

Do not connect 380-500 V CUE frequency converters to mains supplies with a voltage between phase and protective earth of more than 440 V.

In connection with IT mains and earthed delta mains, the mains voltage may exceed 440 V between phase and protective earth.

5.2 Aggressive environment

CUE must not be installed in an environment where the air contains liquids, particles or gases which may affect and damage the electronic components.

CUE contains a large number of mechanical and electronic components. They are all vulnerable to environmental impact.

5.3 Reduced performance under certain conditions

CUE reduces its performance under these conditions:

- low air pressure (at high altitude)
- long motor cables.

The required measures are described in the next two sections.

5.3.1 Reduction at low air pressure

At altitudes above 2000 m (6600 ft), the PELV requirements cannot be met.

PELV = Protective Extra Low Voltage.

At low air pressure, the cooling capacity of air is reduced, and CUE automatically reduces the performance to prevent overload.

It may be necessary to select a CUE unit with a higher performance.

5.3.2 Reduction in connection with long motor cables

The maximum cable length is 300 m (1000 ft) for unscreened and 150 m (500 ft) for screened cables. In case of longer cables, contact Grundfos.

CUE is designed for a motor cable with a maximum cross-section as stated in section *13.3.4 Non-UL fuses and conductor cross-section to mains and motor, for installations outside North America* and *13.3.5 UL fuses and conductor cross-section to mains and motor, for installations in North America*.

6. Mechanical installation

The individual CUE cabinet sizes are characterized by their enclosures. The table in section *13.1 Enclosure* shows the relationship between enclosure class and enclosure type.

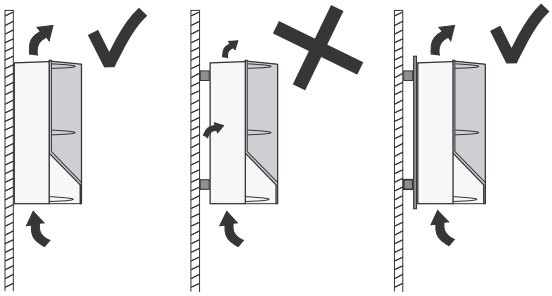
6.1 Enclosure types

Products with integrated STO function must be installed in an IP54 cabinet according to IEC 60529 or in an equivalent environment. In special applications, a higher IP degree may be necessary.

6.2 Space requirements and air circulation

CUE units can be mounted side by side, but as sufficient air circulation is required for cooling, these requirements must be met:

- Sufficient free space above and below the CUE cabinet. See the table below.
- Ambient temperature up to 50 °C (122 °F)
- Hang the CUE cabinet directly on the wall, or fit it with a back plate. See fig. 4.



TM03 8859 2607

Fig. 4 CUE hung directly on the wall or fitted with a back plate

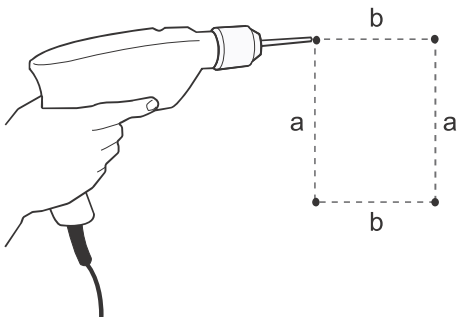
Required free space above and below the CUE cabinet

Enclosure	Space [mm (in)]
A2, A3, A4, A5	100 (3.9)
B1, B2, B3, B4, C1, C3	200 (7.9)
C2, C4, D1h, D2h	225 (8.9)

6.3 Mounting

The user is responsible for mounting CUE securely on a firm surface.

1. Mark and drill holes. See section *13.5.1 Enclosures A2-A5, B1-B4 and C1-C4.*.
2. Fit the screws at the bottom, but leave loose. Mount CUE, and tighten the four screws.



TM03 8860 2607

Fig. 5 Drilling of holes in the wall

6.4 Mounting on the floor

WARNING

Crushing of feet

Death or serious personal injury

- CUE is very heavy and may fall if the pedestal is not anchored to the floor.

The user is responsible for mounting CUE securely on a firm surface.

See the pedestal-kit instructions for further information.

By means of a pedestal (optional), CUE can also be mounted on the floor.

1. Mark the mounting holes on the floor. See fig. 6.
2. Drill the holes.
3. Mount the pedestal on the floor.
4. Mount CUE on the pedestal using the enclosed screws.

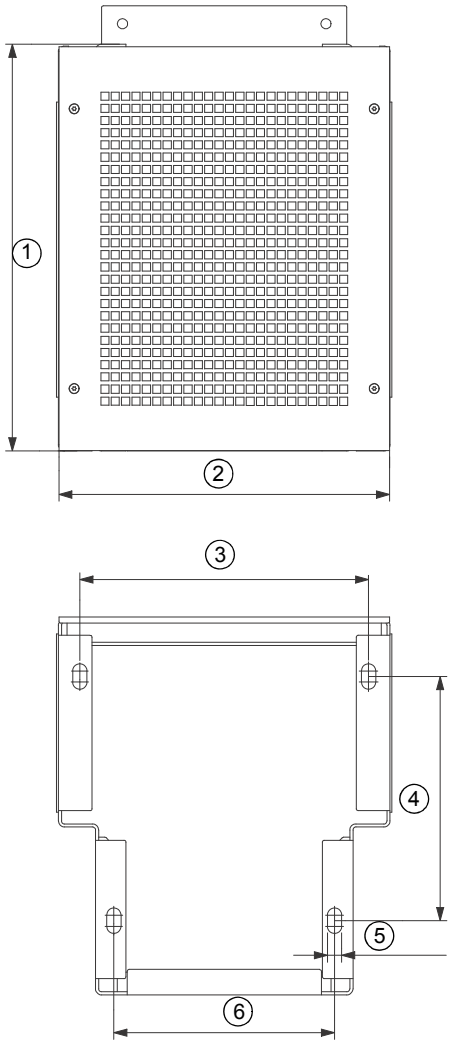


Fig. 6 Drilling template for pedestal

Pos.	D1h [mm]	D2h [mm]
1	400	400
2	325	420
3	283.8	378.8
4	240	240
5	4 x 14	4 x 14
6	217	317

7. Electrical connection

WARNING

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on. See *5. Installation requirements*.
- Touching the electrical parts may be fatal, even after CUE has been switched off.

The owner or installer is responsible for ensuring correct earthing and protection according to local standards.

For products with STO, ensure short-circuit protection of the cable between terminal 37 and the external safety device.

Security measures are the responsibility of the user.

The frequency converter parameters can be password protected.

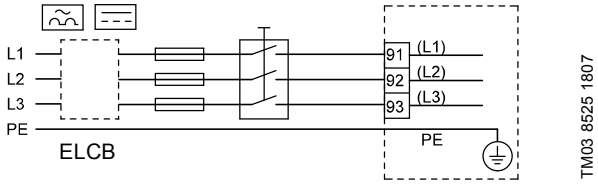


Fig. 7 Example of three-phase mains connection of CUE with main switch, backup fuses and additional protection

7.1 Electrical protection

7.1.1 Protection against electric shock, indirect contact

CAUTION

Electric shock

Minor or moderate personal injury

- CUE must be earthed correctly and protected against indirect contact according to local regulations.

The leakage current to protective earth exceeds 3.5 mA, and a reinforced earth connection is required.

Protective conductors must always have a yellow and green (PE) or yellow, green and blue (PEN) color marking.

Instructions according to EN IEC 61800-5-1:

- CUE must be stationary, installed permanently and connected permanently to the mains supply.
- The protective earth connection must be carried out with duplicate protective conductors or with a single reinforced protective conductor with a cross-section of minimum 10 mm^2.

7.1.2 Protection against short circuit, fuses

CUE and the supply system must be protected against short circuit.

Grundfos requires that the backup fuses mentioned in section *13.3.3 Cable cross-section to signal terminals* are used for protection against short circuit.

CUE offers complete short-circuit protection in case of a short circuit on the motor output.

7.1.3 Additional protection

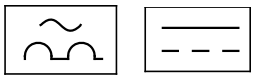
WARNING

Electric shock

Death or serious personal injury

- The leakage current to protective earth exceeds 3.5 mA.

If CUE is connected to an electrical installation where an earth leakage circuit breaker (ELCB/RCD) is used as additional protection, the circuit breaker must be of a type marked with the following symbols:



ELCB/RCD

The circuit breaker is type B.

The total leakage current of all the electrical equipment in the installation must be taken into account.

The leakage current of CUE in normal operation can be seen in section *13.4 Electrical data*.

During startup and in asymmetrical supply systems, the leakage current can be higher than normal and may cause the ELCB/RCD to trip.

7.1.4 Motor protection

The motor requires no external motor protection. CUE protects the motor against thermal overloading and blocking.

7.1.5 Protection against overcurrent

CUE has an internal overcurrent protection for overload protection on the motor output.

7.1.6 Protection against mains voltage transients

CUE is protected against mains voltage transients according to EN 61800-3, second environment.

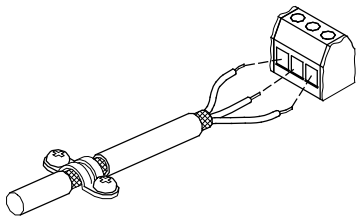
7.2 EMC-correct installation

The motor cable must be screened for CUE to meet EMC requirements.

This section provides guidelines for good practice when installing CUE. Follow these guidelines to meet EN 61800-3, first environment.

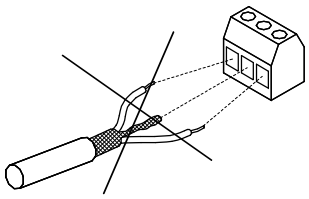
- Use only motor and signal cables with a braided metal screen in applications without output filter.
- There are no special requirements to supply cables, apart from local requirements.
- Leave the screen as close to the connecting terminals as possible. See fig. 7.
- Avoid terminating the screen by twisting the ends. See fig. 9. Use cable clamps or EMC screwed cable entries instead.
- Connect the screen to frame at both ends for both motor and signal cables. See fig. 10. If the controller has no cable clamps, connect only the screen to the CUE cabinet. See fig. 11.
- Avoid unscreened motor and signal cables in electrical cabinets with frequency converters.
- Make the motor cable as short as possible in applications without output filter to limit the noise level and minimise leakage currents.
- Screws for frame connections must always be tightened whether a cable is connected or not.
- Keep mains cables, motor cables and signal cables separated in the installation if possible.

Other installation methods may give similar EMC results if the above guidelines for good practice are followed.



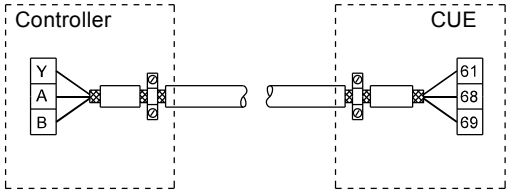
TM02 1325 0901

Fig. 8 Example of stripped cable with screen



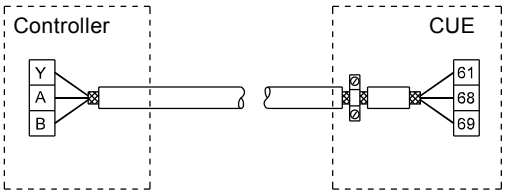
TM03 8812 2507

Fig. 9 Do not twist the screen ends



TM03 8732 2407

Fig. 10 Example of connection of a 3-conductor bus cable with screen connected at both ends



TM03 8731 2407

Fig. 11 Example of connection of a 3-conductor bus cable with screen connected to CUE (controller with no cable clamps)

7.3 RFI filters

To meet the EMC requirements, CUE comes with the following types of built-in radio-frequency interference filter (RFI).

Voltage [V]	Typical shaft power P2 [kW (hp)]	RFI filter type
1 x 200-240*	1.1 - 7.5 (1.5 - 10 hp)	C1
3 x 200-240	0.75 - 45 (1-60 hp)	C1
3 x 380-500	0.55 - 90 (0.75 - 125 hp)	C1
3 x 380-500	110-250 (150-350 hp)	C3
3 x 525-600	0.75 - 7.5 (1-10 hp)	C3
3 x 525-690	11-250 (15-350 hp)	C3

* Single-phase input - three-phase output.

Description of RFI filter types

C1:	For use in domestic areas.
C3:	For use in industrial areas with own low-voltage transformer.

RFI filter types are according to EN 61800-3.

Equipment of category C3

- This type of power drive system (PDS) is not intended to be used on a low-voltage public network which supplies domestic premises.
- Radio frequency interference is expected if used on such a network.

7.3.1 Output filters

Output filters are used for reducing the voltage stress on the motor windings and the stress on the motor insulation system as well as for decreasing acoustic noise from the frequency converter-driven motor.

Two types of output filters are available as accessories for CUE:

- dU/dt filters
- sine-wave filters.

Use of output filters

The table below shows when we recommend an output filter and the type to use. The selection depends on the following:

- pump type
- motor cable length
- the required reduction of the acoustic noise from the motor.

Pump type	dU/dt filter	Sine-wave filter
SP, BM, BMB with motor voltage from 380 V and up	-	0-300 m* (0-984 ft)
Pumps with Grundfos motor ML71 and ML80 up to and including 1.5 kW (2 hp)	-	0-300 m* (0-984 ft)
Applications with desired reduction of dU/dt and noise emission, low reduction	0-150 m*	-
Applications with desired reduction of dU/dt, voltage peaks and noise emission, high reduction	-	0-300 m* (0-984 ft)
Applications with motors of 500 V and up	-	0-300 m* (0-984 ft)

* The lengths stated apply to the motor cable.

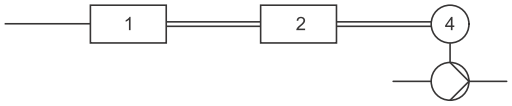
7.4 Motor cable

To meet EN 61800-3, the motor cable must always be a screened cable, whether an output filter is installed or not.

The mains cable need not be a screened cable. See figs 12, 13, 14 and 15.

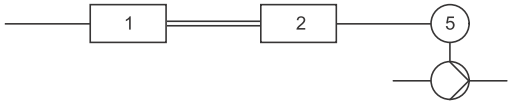
TM04 4289 1109

Fig. 12 Example of installation without filter



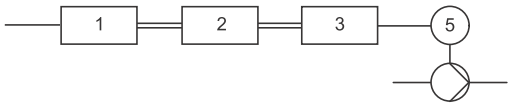
TM04 4290 1109

Fig. 13 Example of installation with filter. The cable between CUE and filter must be short



TM04 4291 1109

Fig. 14 Submersible pump without connection box. Frequency converter and filter installed close to the well



TM04 4292 1109

Fig. 15 Submersible pump with connection box and screened cable. Frequency converter and filter installed far away from the well and connection box installed close to the well

Symbol	Designation
1	CUE
2	Filter
3	Connection box
4	Standard motor
5	Submersible motor
One line	Unscreened cable
Double line	Screened cable

7.5 Mains and motor connection

Check that the mains voltage and frequency correspond to the values on the nameplate of CUE and the motor.

The motor cable must be screened for CUE to meet EMC requirements.

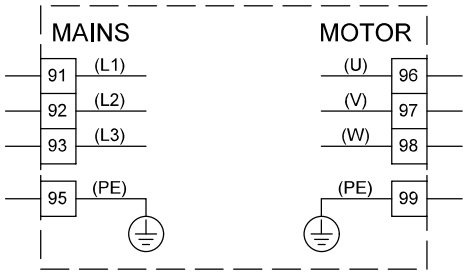
The supply voltage and frequency are marked on the CUE nameplate. Make sure that CUE is suitable for the power supply of the installation site.

7.5.1 Main switch

A main switch can be installed before the CUE cabinet according to local regulations. See fig. 7.

7.5.2 Wiring diagram

The wires in the terminal box must be as short as possible. Excepted from this is the protective conductor which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.



TM03 8799 2507

Fig. 16 Wiring diagram, three-phase mains connection

Terminal		Function
91	(L1)	Three-phase mains supply
92	(L2)	
93	(L3)	
95/99	(PE)	Protective earth connection
96	(U)	Three-phase motor connection, 0-100 % of mains voltage
97	(V)	
98	(W)	

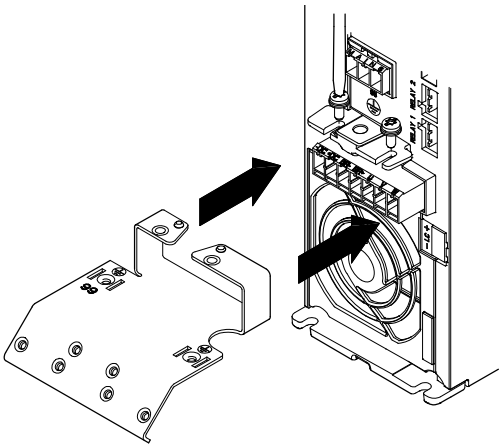
For single-phase connection, use L1 and L2.

7.5.3 Mains connection, enclosures A2 and A3

Check that the mains voltage and frequency correspond to the values on the nameplate of CUE and the motor.

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
A2	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
A3	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)

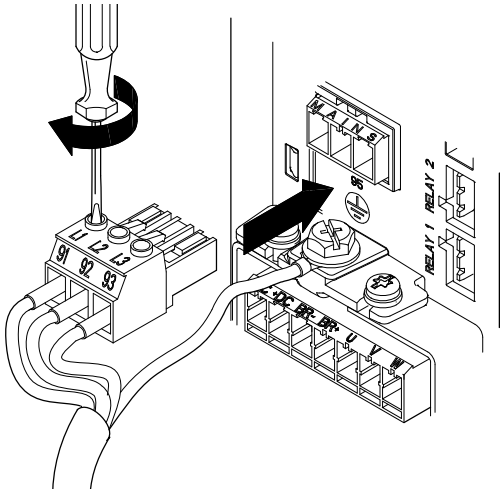
1. Fit the mounting plate with two screws.



TM03 9010 2807

Fig. 17 Fitting the mounting plate

2. Connect the earth conductor to terminal 95 (PE) and the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3) of the mains plug.

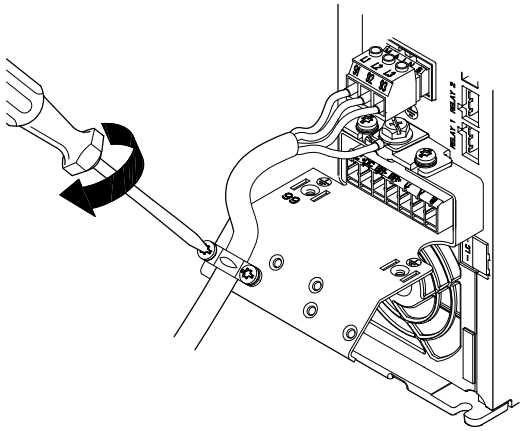


TM03 9011 2807

Fig. 18 Connecting the earth conductor and mains conductors

For single-phase connection, use L1 and L2.

3. Fix the mains cable to the mounting plate.

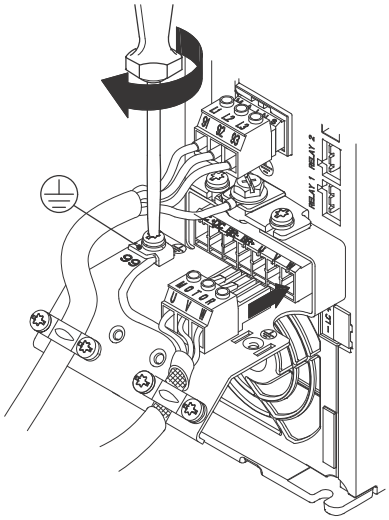


TM03 9014 2807

Fig. 19 Fixing the mains cable

7.5.4 Motor connection, enclosures A2 and A3

1. Connect the earth conductor to terminal 99 (PE) on the mounting plate.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W) of the motor plug.



TM07 4879 2619

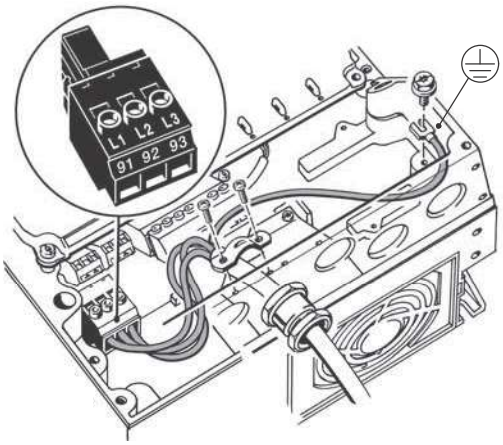
Fig. 20 Connecting the earth conductor and motor conductors

3. Put the motor plug into the socket marked "MOTOR".
4. Fix the screened cable to the mounting plate with a cable clamp.

7.5.5 Mains connection, enclosures A4 and A5

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
A4	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
A5	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See fig. 21.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3) of the mains plug.
3. Put the mains plug into the socket marked "MAINS".
4. Fix the mains cable with a cable clamp.



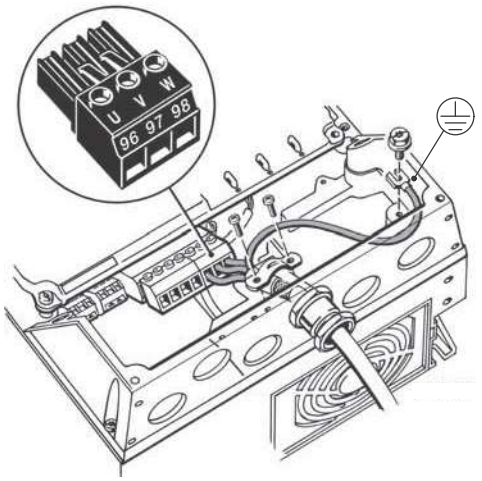
TM03 9017 2619

Fig. 21 Mains connection, A4 and A5

For single-phase connection, use L1 and L2.

7.5.6 Motor connection, enclosures A4 and A5

1. Connect the earth conductor to terminal 99 (PE). See fig. 22.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W) of the motor plug.
3. Put the motor plug into the socket marked "MOTOR".
4. Fix the screened cable with a cable clamp.



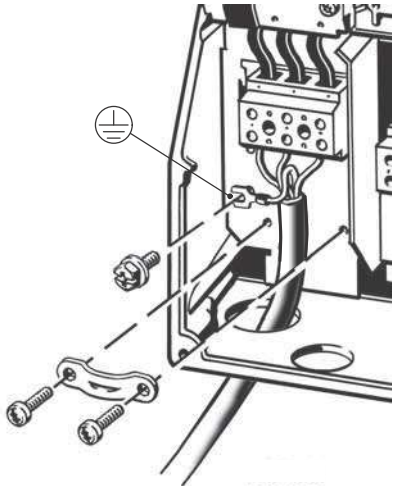
TM03 9018 2619

Fig. 22 Motor connection, A4 and A5

7.5.7 Mains connection, enclosures B1 and B2

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
B1	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
B2	4.5 (3.3)	4.5 (3.3)	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See fig. 23.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.



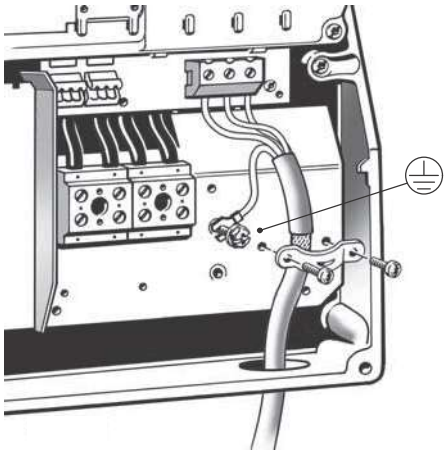
TM03 9019 2619

Fig. 23 Mains connection, B1 and B2

For single-phase connection, use L1 and L2.

7.5.8 Motor connection, enclosures B1 and B2

1. Connect the earth conductor to terminal 99 (PE). See fig. 24.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9020 2619

Fig. 24 Motor connection, B1 and B2

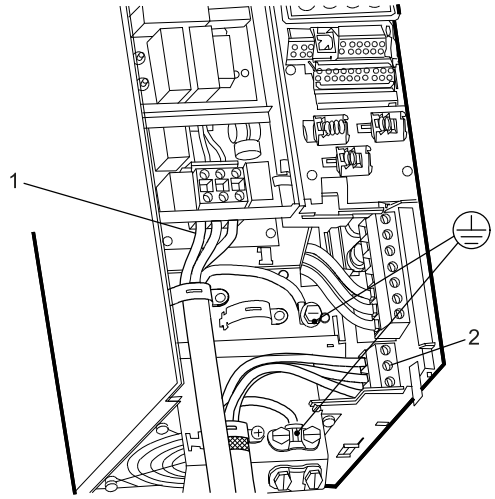
7.5.9 Mains connection, enclosures B3 and B4

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
B3	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
B4	4.5 (3.3)	4.5 (3.3)	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See figs 25 and 26.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

7.5.10 Motor connection, enclosures B3 and B4

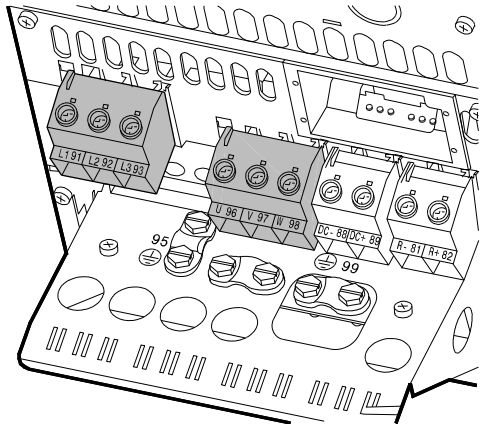
1. Connect the earth conductor to terminal 99 (PE). See figs 25 and 26.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9446 4007

Fig. 25 Mains and motor connection, B3

Pos.	Description
1	Mains
2	Motor



TM03 9449 4007

Fig. 26 Mains and motor connection, B4

7.5.11 Mains connection, enclosures C1 and C2

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
C1	10 (7.4)	10 (7.4)	3 (2.2)	0.6 (0.4)
C2	14[1)]/24[2)] (10.3[1)]/17.7[2)])	14[1)]/24[2)] (10.3[1)]/17.7[2)])	3 (2.2)	0.6 (0.4)

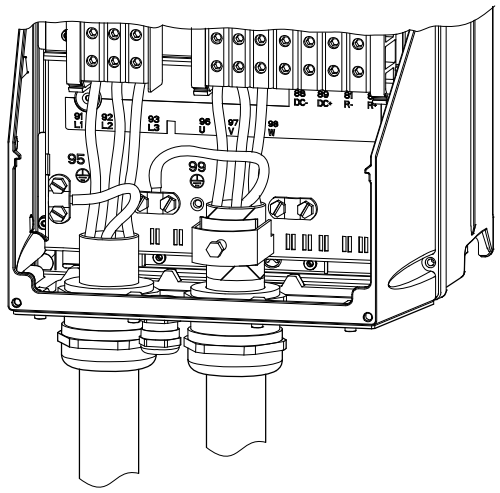
[1)] Conductor cross-section ≤ 95 mm² (≤ 4/0 AWG)

[2)] Conductor cross-section ≥ 95 mm² (≥ 4/0 AWG).

1. Connect the earth conductor to terminal 95 (PE). See fig. 27.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).

7.5.12 Motor connection, enclosures C1 and C2

1. Connect the earth conductor to terminal 99 (PE). See fig. 27.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9016 2807

Fig. 27 Mains and motor connection, C1 and C2

7.5.13 Mains connection, enclosures C3 and C4

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
C3	10	10	3 (2.2)	0.6 (0.4)
C4	14[1)]/24[2)] (10.3[1)]/17.7[2)])	14[1)]/24[2)] (10.3[1)]/17.7[2)])	3 (2.2)	0.6 (0.4)

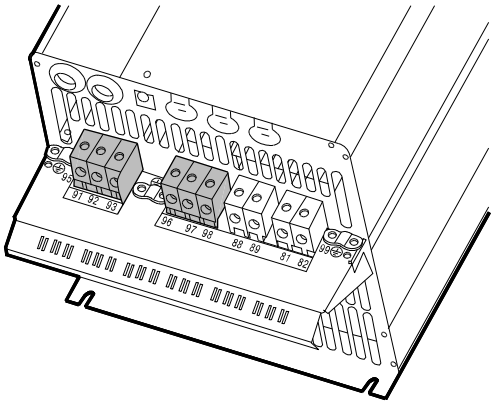
[1)] Conductor cross-section ≤ 95 mm² (≤ 4/0 AWG)

[2)] Conductor cross-section ≥ 95 mm² (≥ 4/0 AWG).

1. Connect the earth conductor to terminal 95 (PE). See figs 28 and 29.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

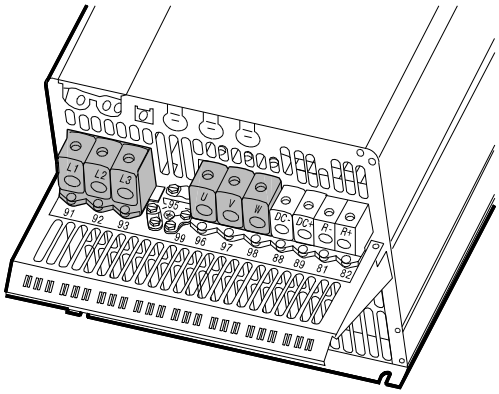
7.5.14 Motor connection, enclosures C3 and C4

1. Connect the earth conductor to terminal 99 (PE). See figs 28 and 29.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9448 4007

Fig. 28 Mains and motor connection, C3



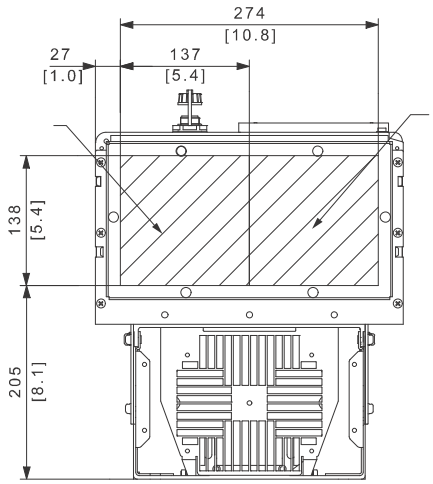
TM03 9447 4007

Fig. 29 Mains and motor connection, C4

7.5.15 Gland plate, enclosures D1h and D2h

Cables are connected through the gland plate from the bottom. The gland plate must be fitted to CUE to ensure the specified protection degree as well as to ensure sufficient cooling.

Drill holes in the marked areas. See fig. 30.



TM05 9326 3713

Fig. 30 CUE viewed from the bottom [mm]

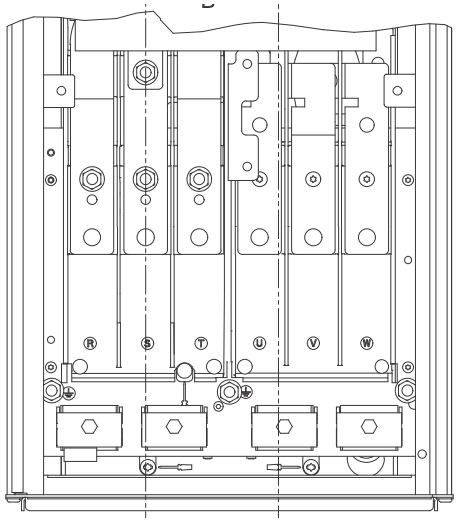
7.5.16 Mains connection, enclosures D1h and D2h

Enclosure	Torque [ft-lb (Nm)]			
	Mains	Motor	Protective earth	Relay
D1h	19-40	19-40	3 (2.2)	0.6 (0.4)
D2h	19-40	19-40	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See fig. 31.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

7.5.17 Terminal location

Take the following terminal positions into consideration when you design the cable connection. See fig. 31.



TM05 9329 3713

Fig. 31 Earth, mains and motor connection for D1h and D2h

7.5.18 Motor connection, enclosures D1h and D2h

1. Connect the earth conductor to terminal 99 (PE). See fig. 31.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.

7.6 STO installation, optional

DANGER

Exposure to high pressure or toxic liquids

Death or serious personal injury

- Failure to remove the jumper will disable the STO function and the motor might not stop as intended and can cause severe injury or death.
- Failure to use safety-monitoring relay compliant with Category 3 /PL "d", ISO 13849-1 or SIL 2, EN 62061 and IEC 61508. Perform a functional test every 12 months to ensure that the system works properly.

To enable the integrated STO, follow these steps:

1. Remove the jumper wire between control terminals 37 and 12 or 13. Cutting or breaking the jumper is not sufficient to avoid short-circuiting.

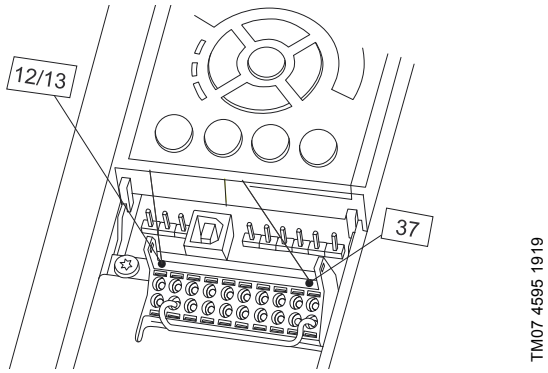


Fig. 32

2. Connect an external safety-monitoring relay via a NO safety function to terminal 37 (STO) and either terminal 12 or 13, 24 V DC.

Select and apply the components in the safety control system appropriately to achieve the desired level of operational safety. Before integrating and using STO in an installation, carry out a thorough risk analysis on the installation to determine whether the STO functionality and safety levels are appropriate and sufficient.

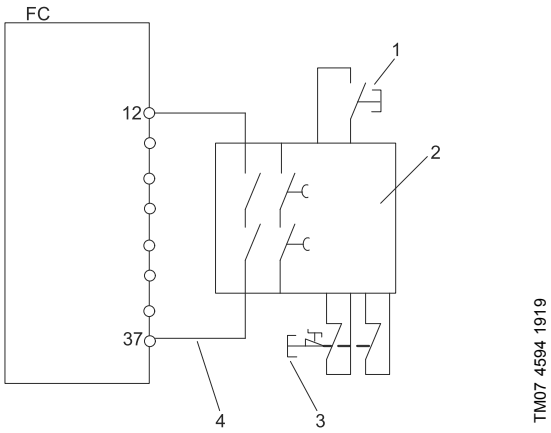


Fig. 33 STO wiring

Pos.	Description
1	Reset button
2	Safety relay (category 3, PL d or SIL2)
3	Emergency stop button
4	Short-circuit protected cable if the product is not installed inside an IP54 cabinet.

7.6.1 Restart behavior after STO activation

By default the STO function is set to unintended-restart prevention behavior. To terminate STO and resume normal operation with manual reset, do the following:

- Reapply 24 V DC supply to terminal 37.
- Send a reset signal via bus, Digital I/O or the reset button.
- Set the STO function to automatic restart by changing the value of 5-19 terminal 37 "Safe Stop" from default value 1, "Safe Stop Alarm" to value 3, "Safe Stop Warning".

Automatic restart means that STO is terminated, and normal operation is resumed, as soon as the 24 V DC is applied to terminal 37. No reset signal is required.

7.6.2 Restart settings

- Remove the 24 V DC voltage supply to terminal 37 using the interrupt device while the frequency converter drives the motor, that is the mains supply is not interrupted.
- Check that the motor coasts and that the alarm Safe Stop displays in the local operating panel if mounted.
- Reapply 24 V DC to terminal 37.
- Ensure that the motor remains in the coasted state.
- Send reset signal via bus, Digital I/O or the reset button.
- Ensure that the motor becomes operational again.

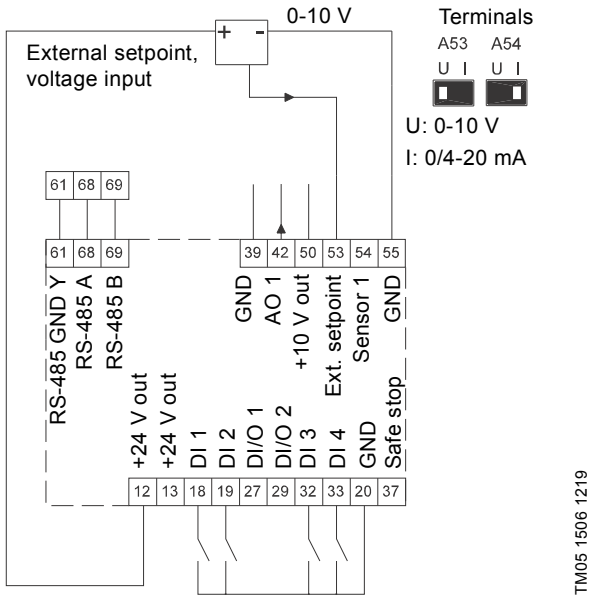
7.7 Connecting the signal terminals

As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.

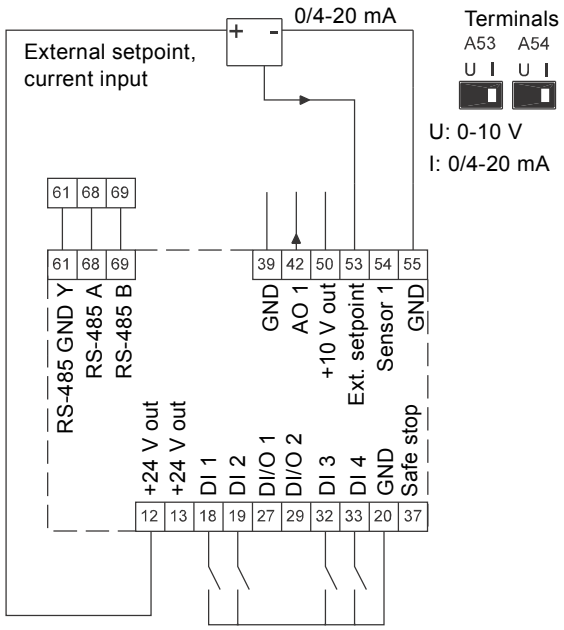
Connect the signal cables according to the guidelines for good practice to ensure EMC-correct installation. See section *7.6.1 Restart behavior after STO activation*.

- Use screened signal cables with a conductor cross-section of minimum 0.5 mm^2 and maximum 1.5 mm^2.
- Use a 3-conductor screened bus cable in new systems.

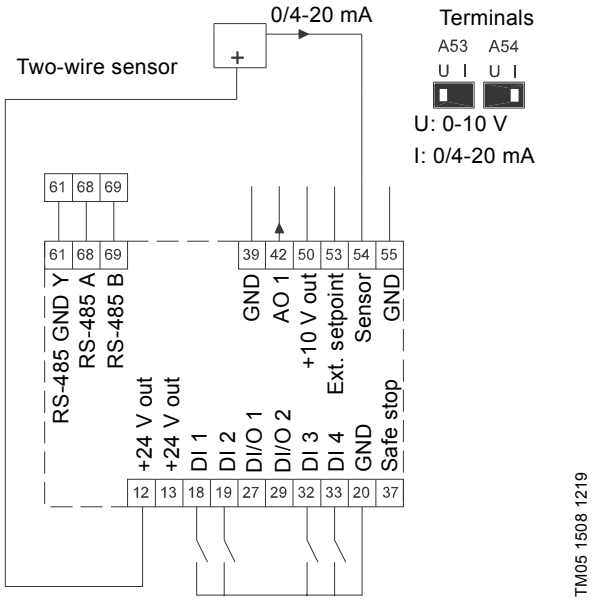
7.7.1 Wiring diagram, signal terminals



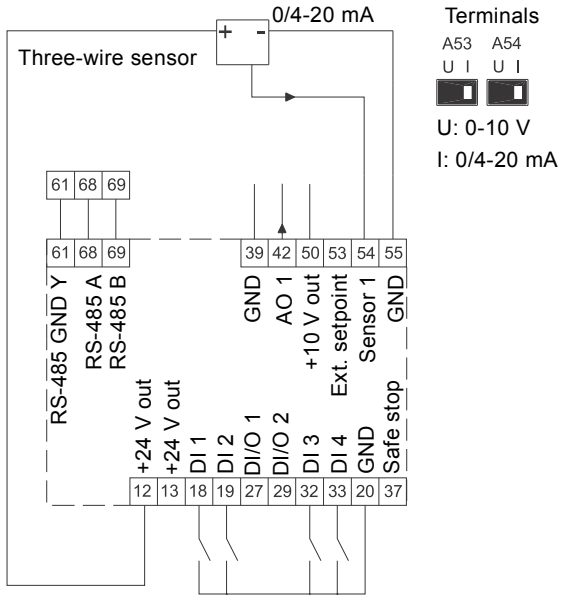
TM05 1506 1219



TM05 1507 1219



TM05 1508 1219



TM07 5269 3619

Terminal	Type	Function	Terminal	Type	Function
12	+24 V out	Supply to sensor	39	GND	Frame for analog output
13	+24 V out	Additional supply	42	AO 1	Analog output, 0-20 mA
18	DI 1	Digital input, programmable	50	+10 V out	Supply to potentiometer
19	DI 2	Digital input, programmable	53	AI 1	External setpoint, 0-10 V, 0/4-20 mA
20	GND	Common frame for digital inputs	54	AI 2	Sensor input, sensor 1, 0/4-20 mA
27	DI/O 1	Digital input/output, programmable	55	GND	Common frame for analog inputs
29	DI/O 2	Digital input/output, programmable	61	RS-485 GND Y	GENIbus, frame
32	DI 3	Digital input, programmable	68	RS-485 A	GENIbus, signal A (+)
33	DI 4	Digital input, programmable	69	RS-485 B	GENIbus, signal B (-)
37	Safe stop	Safe stop			

The RS-485 screen must be connected to frame.

7.7.2 Connection of a thermistor (PTC) to CUE

The connection of a thermistor (PTC) in a motor to CUE requires an external PTC relay.

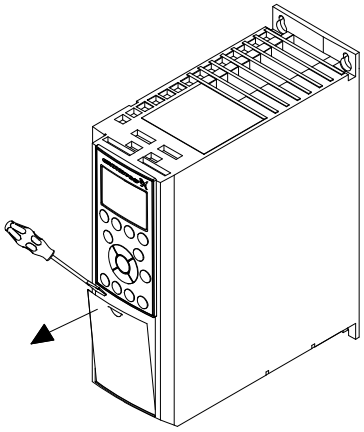
The requirement is based on the fact that the thermistor in the motor only has one layer of insulation to the windings. The terminals in CUE require two layers of insulation since they are part of a PELV circuit.

A PELV circuit provides protection against electric shock. Special connection requirements apply to this type of circuit. The requirements are described in EN 61800-5-1.

In order to maintain PELV, all connections made to the control terminals must be PELV. For example, the thermistor must have reinforced or double insulation.

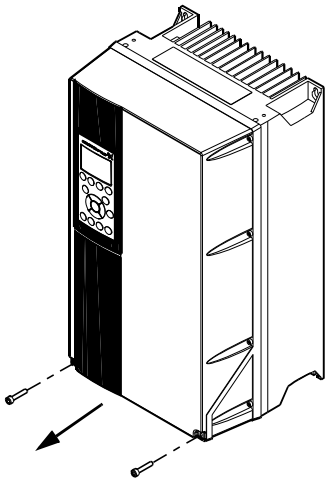
Access to signal terminals

All signal terminals are behind the terminal cover of the CUE front. Remove the terminal cover as shown in figs 34 and 35.



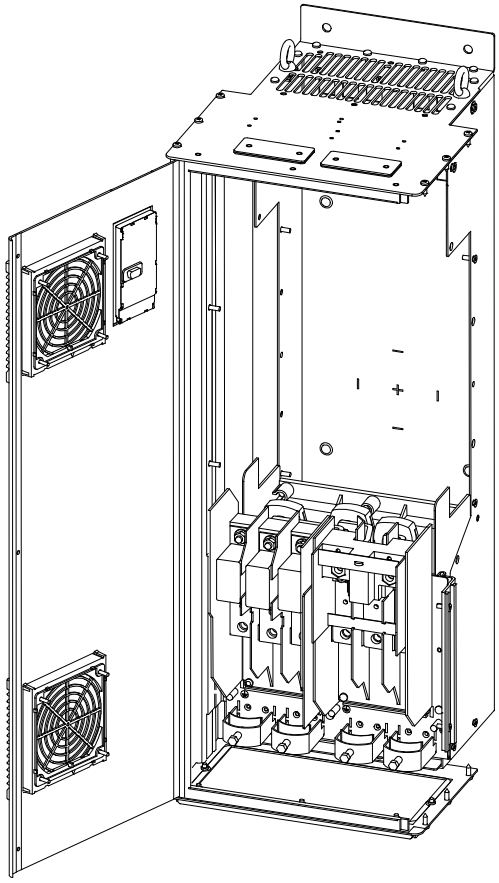
TM03 9003 1219

Fig. 34 Access to signal terminals, A2 and A3



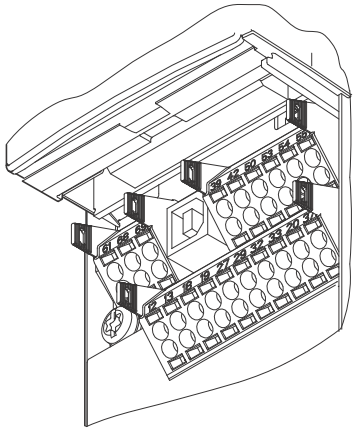
TM03 9004 1219

Fig. 35 Access to signal terminals, A4, A5, B1, B2, B3, B4, C1, C2, C3 and C4



TM05 9654 4213

Fig. 36 Access to signal terminals, D1h and D2h

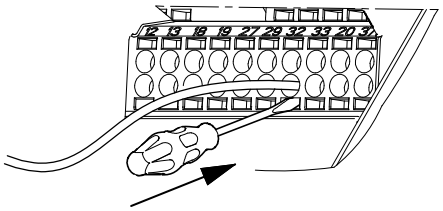


TM03 9025 2807

Fig. 37 Signal terminals, all enclosures

Fitting the conductor

1. Remove the insulation at a length of 9 to 10 mm.
2. Insert a screwdriver with a tip of maximum 0.4 x 2.5 mm into the square hole.
3. Insert the conductor into the corresponding round hole. Remove the screwdriver. The conductor is now fixed in the terminal.



TM03 9026 2807

Fig. 38 Fitting the conductor into the signal terminal

Setting the analog inputs, terminals 53 and 54

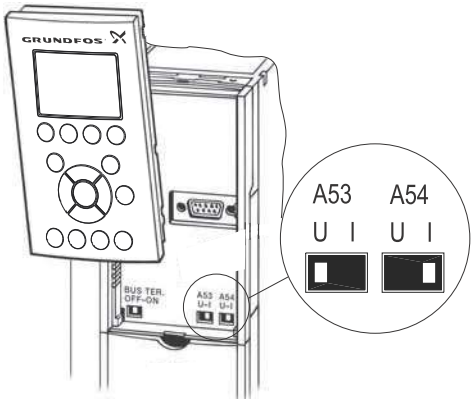
Contacts A53 and A54 are positioned behind the operating panel and used for setting the signal type of the two analog inputs.

The factory setting of the inputs is voltage signal "U".

If a 0/4-20 mA sensor is connected to terminal 54, the input must be set to current signal "I".

Switch off the power supply before setting contact A54.

Remove the operating panel to set the contact. See fig. 39.



TM03 9104 1219

Fig. 39 Setting contact A54 to current signal "I"

RS-485 GENIbus network connection

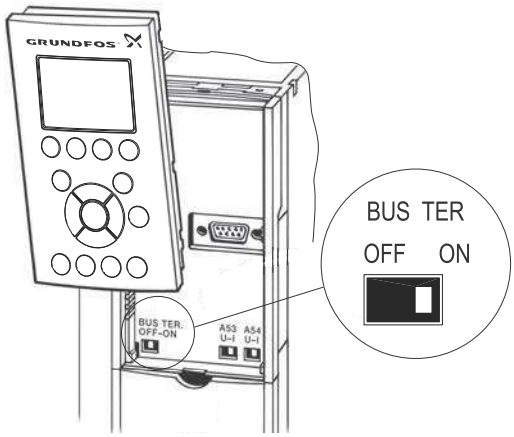
One or more CUE units can be connected to a control unit via GENIbus.

The reference potential, GND, for RS-485 (Y) communication must be connected to terminal 61.

If more than one CUE unit is connected to a GENIbus network, the termination contact of the last CUE must be set to "ON" (termination of the RS-485 port).

The factory setting of the termination contact is "OFF" (not terminated).

Remove the operating panel to set the contact. See fig. 40.

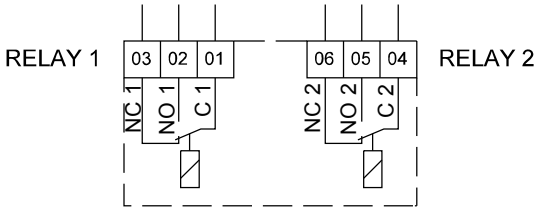


TM03 9006 1219

Fig. 40 Setting the termination contact to "ON"

7.8 Connecting the signal relays

As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.



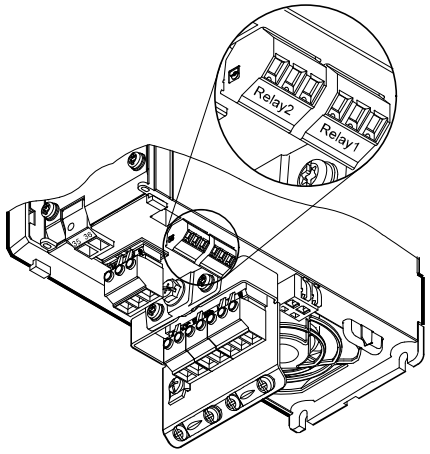
TM03 8801 2507

Fig. 41 Terminals for signal relays in normal state (not activated)

Terminal		Function
C 1	C 2	Common
NO 1	NO 2	Normally open contact
NC 1	NC 2	Normally closed contact

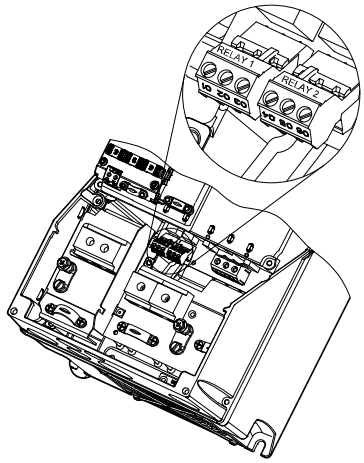
7.8.1 Access to signal relays

The relay outputs are positioned as shown in figs 42 to 47.



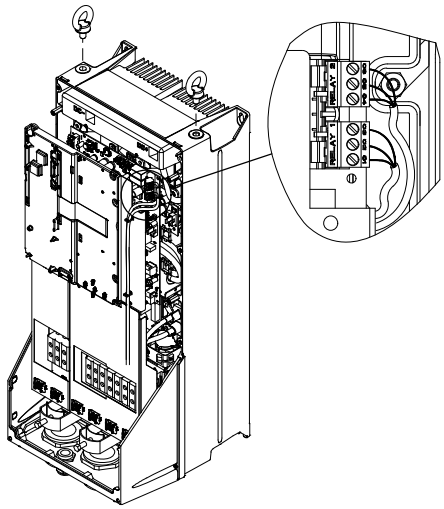
TM03 9007 2807

Fig. 42 Terminals for relay connection, A2 and A3



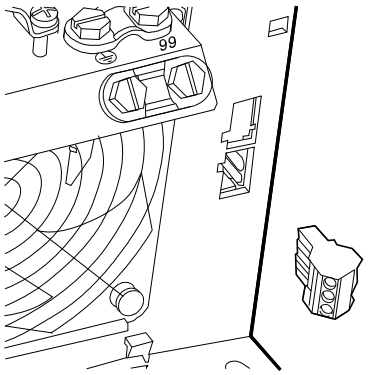
TM03 9008 2807

Fig. 43 Terminals for relay connection, A4, A5, B1 and B2



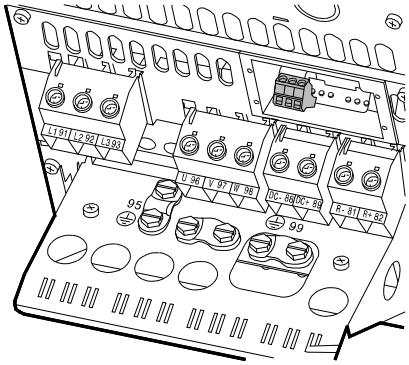
TM03 9009 2807

Fig. 44 Terminals for relay connection, C1 and C2



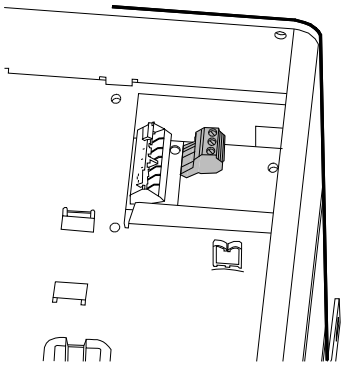
TM03 9442 4007

Fig. 45 Terminals for relay connection, B3



TM03 9441 4007

Fig. 46 Terminals for relay connection, B4



TM03 9440 4007

Fig. 47 Terminals for relay connection, C3, C4, D1h and D2h, in the upper right corner of CUE

7.8.2 Connecting the MCB 114 sensor input module

The MCB 114 is an option offering additional analog inputs for CUE.

Configuration of MCB 114

MCB 114 is equipped with three analog inputs for the following sensors:

- One additional sensor 0/4-20 mA.
- Two Pt100/Pt1000 temperature sensors for measurement of motor bearing temperature or an alternative temperature, such as liquid temperature.

When MCB 114 has been installed, CUE automatically detects if the sensor is Pt100 or Pt1000 when it is switched on.

Wiring diagram, MCB 114

When using Pt100 with a 3-wire cable, the resistance must not exceed 30 Ω.

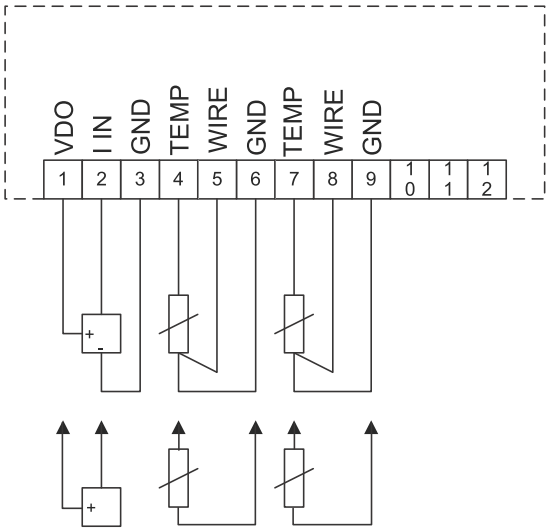


Fig. 48 Wiring diagram, MCB 114

Terminal	Type	Function
1 (VDO)	+24 V out	Supply to sensor
2 (I IN)	AI 3	Sensor 2, 0/4-20 mA
3 (GND)	GND	Common frame for analog input
4 (TEMP) 5 (WIRE)	AI 4	Temperature sensor 1, Pt100/Pt1000
6 (GND)	GND	Common frame for temperature sensor 1
7 (TEMP) 8 (WIRE)	AI 5	Temperature sensor 2, Pt100/Pt1000
9 (GND)	GND	Common frame for temperature sensor 2

Terminals 10, 11 and 12 are not used.

7.8.3 Fitting MCB 114 in CUE

Enclosures A2, A3 and B3

1. Switch off the power to CUE. See section *7.5 Mains and motor connection*.
2. Remove the operating panel, the terminal cover and the frame from CUE. See fig. 49.
3. Fit MCB 114 into port B.
4. Connect the signal cables, and fasten the cables with the enclosed cable strips.
5. Remove the knock-out plate in the extended frame so that MCB 114 fits under the extended frame.
6. Fit the extended frame and the terminal cover.
7. Fit the operating panel in the extended frame.
8. Connect power to CUE.

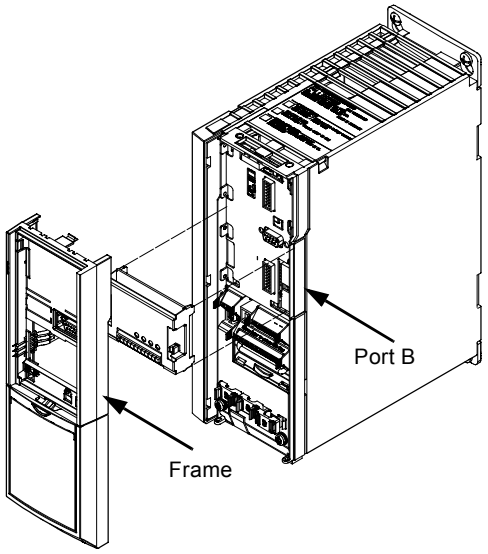


Fig. 49 Enclosures A2, A3 and B3

Enclosures A5, B1, B2, B4, C1, C2, C3, C4, D1 and D2

1. Switch off the power to CUE. See section *7.5 Mains and motor connection*.
2. Remove the operating panel and the cradle from CUE. See fig. 50.
3. Fit MCB 114 into port B.
4. Connect the signal cables, and fasten the cables with the enclosed cable strips. See fig. 50.
5. Fit the cradle and the operating panel.
6. Connect power to CUE.

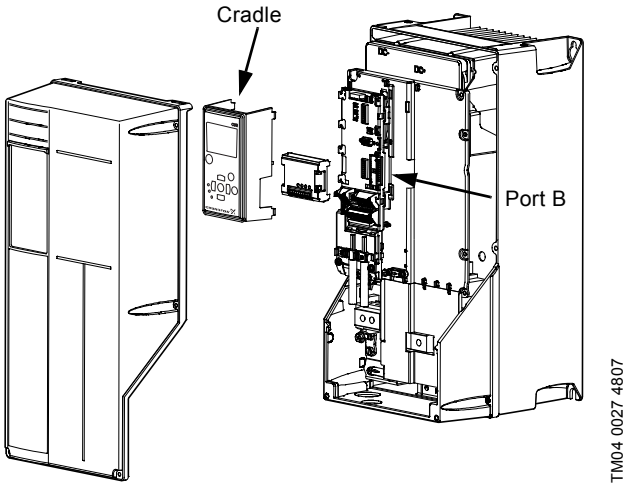


Fig. 50 Enclosures A5, B1, B2, B4, C1, C2, C3, C4, D1 and D2

8. Starting up the product

Any installation, maintenance and inspection must be carried out by trained persons.

Before you switch on the power supply, you must do the following:

- Close the cover.
- Ensure that all cable glands are tightened properly.
- Ensure that there is no voltage on output terminals, phase-to-phase and phase-to-ground.
- Confirm continuity of the motor by measuring Ω values on U-V, V-W and W-U.
- Check for proper grounding of the frequency converter and the motor.
- Check that there are no loose connections on the terminals.
- Confirm that the supply voltage matches the voltage of the frequency converter and the motor.

8.1 Switching on the product

- Confirm that the input voltage is balanced within 3 %. If not, correct the input-voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
- Ensure that any optional equipment wiring matches the installation application.
- Ensure that all operator devices are in the OFF position. The panel doors must be closed, and covers must be securely fastened.
- Apply power to the unit, but do not start the frequency converter yet. For units with a disconnect switch, turn it to the ON position to apply power to the frequency converter.

8.2 Activating the optional STO function

The STO function is activated by removing the voltage at terminal 37 of the frequency converter. By connecting the frequency converter to external safety devices providing a safe delay, an installation for a Safe Stop 1 is obtained. External safety devices need to fulfil Cat./PL or SIL when connected to terminal 37.

The STO function can be used for the following motor types:

- asynchronous
- synchronous
- permanent magnet motors.

When terminal 37 is activated, the frequency converter issues an alarm, trips the unit and coasts the motor to a stop. A manual restart is required. Use the STO function to stop the frequency converter in emergency stop situations. In normal operating mode, the STO terminal 37 must be deactivated to start the motor.

A successful commissioning test of the STO function is required after the initial installation and after each subsequent change to the installation.

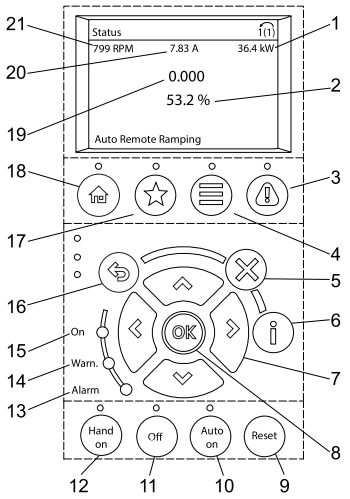
9. Control functions

The display contrast can be adjusted by pressing [Status] and then pressing [Up] or [Down].

9.1 Operating panel

The operating panel consists of a display and several buttons. It enables manual setting and monitoring of the system, such as follows:

- Start, stop and control of speed.
- Reading of operating data and warnings and alarms.
- Setting functions for the frequency converter.
- Manual reset of the frequency converter.



TM07 4597 2119

Fig. 51 Operating panel

Pos.	Buttons	Description
1		Power [kW]
2		Reference [%]
3		[Alarm log]: shows a list of current warnings, the last 10 alarms and the maintenance log.
4		[Main menu]: allows access to all programming settings.
5		[Cancel]: cancels the last change or command as long as the display mode has not changed.
6		[Info]: press for a definition of the function being displayed.
7		[Up]/[Down]/[Left]/[Right]: use the four arrow buttons to navigate between items in the menu.
8	OK	[OK]: used to access parameter groups or to accept a selection.
9	RESET	[RESET]: resets the frequency converter manually after a fault has been cleared.
10	AUTO ON	[AUTO ON]: puts the system in remote operational mode. • Responds to an external start command by control terminals or serial communication.
11	OFF	[OFF]: stops the motor but does not remove power to the frequency converter.
12	HAND ON	[HAND ON]: starts the frequency converter in local control. • An external stop signal by control input or serial communication overrides the local [Hand On] function.
13	[Alarm] Red	A fault condition causes the red alarm light to flash and an alarm text is displayed.
14	[Warn.] Yellow	When warning conditions are met, the yellow warning light comes on and text appears in the display area identifying the problem.
15	[On] Green	The On light activates when the frequency converter receives power from the mains voltage, a DC bus terminal or an external 24 V supply.
16		[Back]: reverts to the previous step or list in the menu structure.
17		[Favorites]: allows access to programming parameters for initial set-up instructions and many detailed application instructions.
18		[Status]: shows operational information.
19		Frequency
20		Motor current
21		Speed, RPM

9.2 Menu overview

Overview of the main menus. The ** represents a number to a submenu.

- "0-** Operation / Display"
- "1-** Load and Motor"
- "2-** Brakes"
- "3-** Reference / Ramps"
- "4-** Limits / Warnings"
- "5-** Digital In/Out"
- "6-** Analog In/Out"
- "8-** Comm. and Options"
- "14-** Special Functions"
- "15-** Drive Information"
- "16-** Data Readouts"
- "18-** Info & Readouts"
- "20-** Drive Closed Loop"
- "21-** Ext. Closed Loop"
- "22-** Appl. Functions"
- "23-** Timer-based Functions"
- "27-** Cascade CTL Option"
- "29-** Water Application Functions"
- "30-** Special Features"
- "35-** Sensor Input Option"
- "200 - Operation Settings"
- "201- Key Functions"
- "202 - Sensors"
- "203 - Status Monitor"

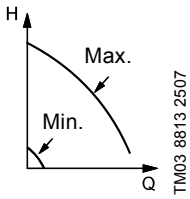
Example: To get to the menu "1-28 Motor Rotation Check", you must do the following:

1. navigate to "1-** Load and Motor", and press [OK].
2. Use the [Up] and [Down] buttons to navigate to "1-2* Motor Data", and press [OK].
3. Use the [Up] and [Down] buttons to navigate to "1-28 Motor Rotation Check", and press [OK] to select the menu.

9.3 Operating modes

The following operating modes are set on the operating panel using the [Favorites] menu.

Operating mode	Description
Normal	The pump is running in the operating mode selected
Stop	The pump has been stopped, and the green indicator light is flashing
Min.	The pump is running at minimum speed
Max.	The pump is running at maximum speed
User curve	The pump is running at user-defined speed



Minimum and maximum curves.
The pump speed is kept at a given set value for minimum and maximum speed.

Example: Maximum curve operation can for instance be used in connection with venting the pump during installation.

Example: Minimum curve operation can for instance be used in periods with a very small flow rate requirement.

9.4 Control modes

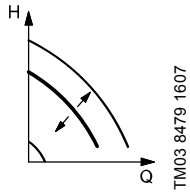
The control mode is set in the [Favorites] menu.

There are two basic control modes:

- Uncontrolled operation (open loop).
- Controlled operation (closed loop) with a sensor connected.

See sections *9.4.1 Uncontrolled operation (open loop)* and *9.4.2 Controlled operation (closed loop)*.

9.4.1 Uncontrolled operation (open loop)

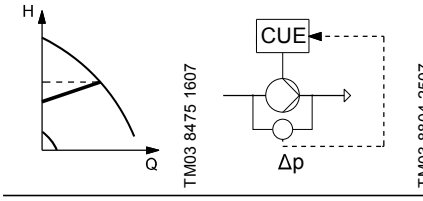
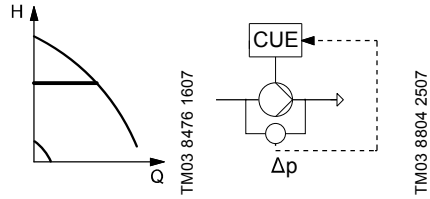
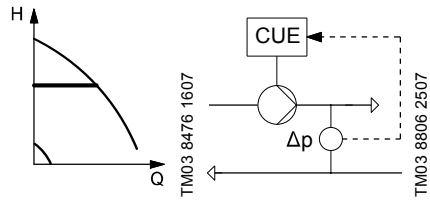
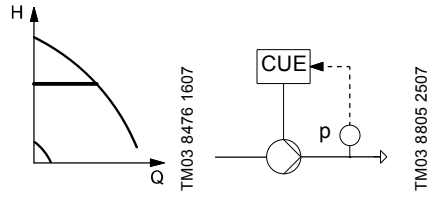
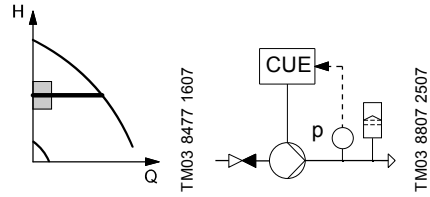
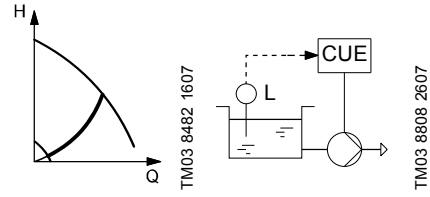
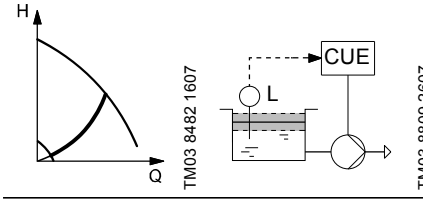
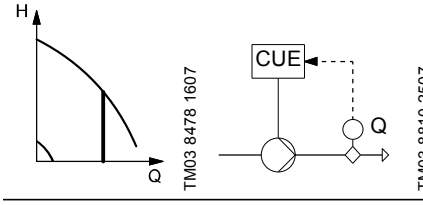
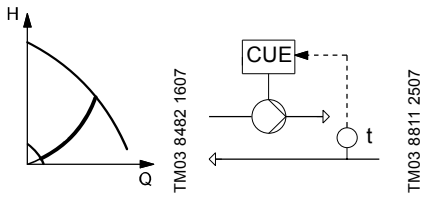


Constant curve.
The speed is kept at a set value in the range between the minimum and maximum curves.
The setpoint is set in % corresponding to the required speed.

Example: Operation on constant curve can for instance be used for pumps with no sensor connected.

Example: Typically used in connection with an overall control system such as MPC or another external controller.

9.4.2 Controlled operation (closed loop)

	Proportional differential pressure. The differential pressure is reduced at falling flow rate and increased at rising flow rate.
	Constant differential pressure, pump. The differential pressure is kept constant, independently of the flow rate.
	Constant differential pressure, system. The differential pressure is kept constant, independently of the flow rate.
	Constant pressure. The pressure is kept constant, independently of the flow rate.
	Constant pressure with stop function. The outlet pressure is kept constant at high flow rate. On/off operation at low flow rate.
	Constant level. The liquid level is kept constant, independently of the flow rate.
	Constant level with stop function. The liquid level is kept constant at high flow rate. On/off operation at low flow rate.
	Constant flow rate. The flow rate is kept constant, independently of the head.
	Constant temperature. The liquid temperature is kept constant, independently of the flow rate.

10. Setting the product

To make a correct programming, it is often necessary to make settings in several submenus. The programmed data is saved internally in the frequency converter.

It is possible to make a backup of the data by uploading the data to the operating panel's memory.

The menus are accessed or changed from [Main Menu] or [Favorites] on the operating panel. However, not all menus are available in [Favorites].

All settings that have been made are visible in [Favorites] > "Q5 - Changes Made".

See *9.1 Operating panel* and *9.2 Menu overview*.

10.1 First-time setup via the startup guide

The startup guide starts automatically the first time the product is switched on or after startup of the frequency converter. The guide enables quick configuration of basic pump- and application parameters.

1. Follow the on-screen instructions to complete the commissioning of the frequency converter. Some data from the motor nameplate is needed.

Reactivate the start-up guide by pressing [Favorites] > "Q4" - "Run start-up guide".

10.2 Uploading or downloading of data

It is possible to download stored data to another frequency converter.

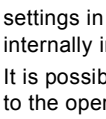
2. Navigate to "0-5* Copy/Save", and press [OK].
3. Press [OK] to activate "0-50 LCP Copy".
4. Press [Up] to select "[1] All to LCP" to upload data to the operating panel, or
5. select "[2] All from LCP" to download data from the operating panel.
6. Press [OK]. A progress bar shows the uploading or downloading progress.

10.3 Asynchronous motor setup

To set an asynchronous motor manually in [Main menu], enter the following motor data available on the motor nameplate.

- "1-20 Motor Power [kW]" or "1-21 Motor Power [HP]"
- "1-22 Motor Voltage"
- "1-23 Motor Frequency"
- "1-24 Motor Current"
- "1-25 Motor Nominal Speed"
- "1-29 Automatic Motor Adaptation (AMA)".

10.4 Checking the motor rotation



There is a risk of damage to the pumps or the compressors if the motor is running in the wrong direction. Before starting the frequency converter, check the motor rotation.

1. Navigate to "1-28 Motor Rotation Check", and press [OK].
2. Scroll to "[1] Enable".

The following text appears: "Note! Motor may run in wrong direction".

3. Press [OK].
4. Follow the on-screen instructions.

To change the direction of rotation, remove power to the frequency converter and wait before touching the product. See waiting time in section *5. Installation requirements*.

- Reverse the connection of any 2 of the 3 motor wires on the motor or frequency-converter side of the connection.

10.5 Permanent-magnet motor setup

To set a permanent-magnet motor manually in [Main menu], enter the motor data available on the motor nameplate.

1. Activate PM motor operation "1-10 Motor Construction", select "[1] PM, non salient SPM."
2. Set "0-02 Motor Speed Unit" to "[0] RPM".

Programme the following parameters in the listed order:

1. "1-24 Motor Current"
2. "1-26 Motor Cont. Rated Torque"
3. "1-25 Motor Nominal Speed"
4. "1-39 Motor Poles"
5. "1-30 Stator Resistance (Rs)". Enter line to common stator winding resistance (Rs). If only line-line data is available, divide the line-line value by 2 to achieve the line-common (starpoint) value.
6. "1-37 d-axis Inductance (Ld)". Enter line to common direct axis inductance of the PM motor. If only line-line data is available, divide the line-line value by 2 to achieve the line-common (starpoint) value.
7. "1-40 Back EMF at 1000 RPM". Enter line-to-line back EMF of the PM motor at 1000 RPM mechanical speed (RMS value). Back EMF is the voltage generated by a PM motor when no frequency converter is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows: If back EMF is for example 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows: Back EMF = (Voltage / RPM)*1000 = (320/1800)*1000 = 178. This is the value that must be programmed for "1-40 Back EMF at 1000 RPM".

10.5.1 Test motor operation

1. Start the motor at low speed (100-200 RPM). If the motor does not turn, check the installation, general programming, and motor data to ensure that it is correct.
2. Check if the start function in "1-70 PM Start Mode" fits the application requirements.

10.6 Synchronous reluctance motor setup

To set a synchronous reluctance motor manually in [Main menu], enter the following motor data available on the motor nameplate:

- "1-10 Motor Construction"
- "1-23 Motor Frequency"
- "1-24 Motor Current"
- "1-25 Motor Nominal Speed"
- "1-26 Motor Cont. Rated Torque"
- "1-29 Automatic Motor Adaptation (AMA)".

10.7 Automatic Energy Optimization (AEO)

AEO is not relevant for permanent-magnet motors.

AEO is a procedure which minimizes voltage to the motor, thereby reducing energy consumption, heat, and noise.

To activate AEO, set "1-03 Torque Characteristics" to "[2] Auto Energy Optim. CT" or "[3] Auto Energy Optim. VT".

10.8 Local-control test

1. Press [Hand On] to provide a local start command to the frequency converter.
2. Accelerate the frequency converter to full speed by pressing [Up]. Moving the cursor left of the decimal point provides quicker input changes.
3. Note any acceleration problems.
4. Press [Off]. Note any deceleration problems.

10.9 System startup

The below steps require wiring and application programming to be completed. We recommend that you follow this procedure after application setup is completed.

1. Press [Auto On].
2. Apply an external run command.
3. Adjust the speed reference throughout the speed range.
4. Remove the external run command.
5. Check the sound and vibration levels of the motor to ensure that the system is working as intended. If warnings or alarms occur, see *12.1 Overview of warnings and alarms* or refer to the service instructions for the frequency converter.

10.10 Resetting to default settings

You can make a backup of the changed settings first by uploading them to the operating panel.

10.10.1 Recommended reset

We recommend that you use "14-22 Operation Mode" to perform a reset to default settings. In this way some settings are kept, such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions.

1. Navigate to "14-** Special Functions", and press [OK].
2. Select "14-22 Operation Mode", and press [OK].
3. Use [Up] and [Down] to navigate to "[2] Initialization", and press [OK].
4. Switch off the power to the unit, and wait for the display to switch off.
5. Reconnect the power.
6. Alarm 80, "Drive initialized to default value", is displayed.
7. Press [Reset] to return to operating mode.

10.10.2 Manual reset

You can also manually reset to default settings, but this deletes all motor-, programming-, localization-, and monitoring data. It will not reset settings for "15-00 Operating hours", "15-03 Power Up's", "15-04 Over Temp's" and "15-05 Over Volt's".

1. Switch off the power to the unit, and wait for the display to switch off.
2. Press and hold [Status], [Main Menu] and [OK] at the same time while switching on the power to the unit. It takes approximately 5 seconds or until you hear an audible click and the fan starts.

11. Servicing the product

CAUTION

Electric shock

Minor or moderate personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on. See *5. Installation requirements*
- Touching the electrical parts may be fatal, even after CUE has been switched off.

Conduct a functional test every 12 months to detect any failure or malfunction of the STO functionality.

To conduct the functional test, perform the following steps:

- Remove the 24 V DC voltage supply at terminal 37.
- Check if the operating panel displays the alarm "Safe Stop A68"
- Verify that the frequency converter trips the unit.
- Verify that the motor is coasting and comes to a complete stop.
- Verify that the motor cannot be started.
- Reconnect the 24 V DC voltage supply to terminal 37.
- Verify that the motor is not started automatically and restarts only by giving a reset signal (via bus, Digital I/O, or the [Reset] button).

12. Fault finding the product

12.1 Overview of warnings and alarms

Type	LED indicator
Warning	Yellow
Alarm	Flashing red
Trip lock	Yellow and red

Number	Description	Warning	Alarm	Alarm, trip lock
1	10 V low	●	-	-
2	Live zero error	(●)	(●)	-
3	No motor	(●)	-	-
4	Mains phase loss	(●)	(●)	(●)
5	DC voltage high	●	-	-
6	DC voltage low	●	-	-
7	DC overvoltage	●	●	-
8	DC undervoltage	●	●	-
9	Inverter overloaded	●	●	-
10	Motor overtemperature	(●)	(●)	-
11	Motor thermistor overtemperature	(●)	(●)	-
12	Torque limit	●	●	-
13	Overcurrent	●	●	●
14	Protective earth fault	-	●	●
15	Hardware mismatch	-	●	●
16	Short circuit	-	●	●
17	Control word timeout	(●)	(●)	-
18	Start failed	-	●	-
21	Parameter error	●	●	-
23	Internal fan fault	●	-	-
24	External fan fault	●	-	-
25	Brake resistor short circuit	●	-	-
26	Brake resistor power limit	(●)	(●)	-
27	Brake chopper fault	●	●	-
28	Brake check failed	(●)	(●)	-
29	Heat sink temperature	●	●	●
30	Motor phase U missing	(●)	(●)	(●)
31	Motor phase V missing	(●)	(●)	(●)
32	Motor phase W missing	(●)	(●)	(●)
33	Inrush fault	-	●	●
34	Fieldbus communication fault	●	●	-
35	Option fault	(●)	-	-
36	Mains failure	●	●	-
38	Internal fault	-	●	●
39	Heat sink sensor	-	●	●
40	Overload of digital output terminal 27	(●)	-	-
41	Overload of digital output terminal 29	(●)	-	-
42	Overload X30/6 or X30/7	(●)	-	-
45	Protective earth fault 2	●	●	●
46	Power card supply	-	●	●
47	24 V supply low	●	●	●
48	1.8 V supply low	-	●	●
49	Speed limit	●	-	-

Number	Description	Warning	Alarm	Alarm, trip lock
50	AMA calibration failed	-	●	-
51	AMA check U_{nom} and I_{nom}	-	●	-
52	AMA low I_{nom}	-	●	-
53	AMA motor too large	-	●	-
54	AMA motor too small	-	●	-
55	AMA parameter out of range	-	●	-
56	AMA interrupted by user	-	●	-
57	AMA timeout	-	●	-
58	AMA internal fault	●	●	-
59	Current limit	●	-	-
60	External interlock	●	●	-
61	Feedback error	(●)	(●)	-
62	Output frequency at maximum limit	●	-	-
64	Voltage limit	●	-	-
65	Control card overtemperature	●	●	●
66	Heat sink temperature low	●	-	-
67	Option configuration has changed	-	●	-
68	Safe stop activated	(●)	(●)[1]	-
69	Power card temperature	-	●	●
70	Illegal FC configuration	-	-	●
71	PTC 1 safe stop	●	●	-
72	Dangerous failure	●	●	●
76	Power unit setup	●	-	-
77	Reduced power mode	●	-	-
79	Illegal power section configuration	-	●	-
80	Drive initialized to default value	-	●	-
81	CSIV corrupt	-	●	-
82	CSIV parameter error	-	●	-
90	Feedback monitor	(●)	(●)	-
91	Analog input 54 wrong settings	-	-	●
92	No flow	(●)	(●)	-
93	Dry pump	(●)	(●)	-
94	End of curve	(●)	(●)	-
95	Broken belt	(●)	(●)	-
96	Start delayed	(●)	-	-
97	Stop delayed	(●)	-	-
98	Clock fault	●	-	-
99	Locked rotor	-	●	-
100	Derag limit fault	-	●	(●)
104	Mixing fan fault	(●)	(●)	-
148	System temperature	●	●	-
200	Fire mode	(●)	-	-
201	Fire mode was active	(●)	-	-
243	Brake IGBT	●	●	-
244	Heat sink temperature	●	●	●
245	Heat sink sensor	-	●	●
246	Power card supply	-	●	●
247	Power card temperature	-	●	●
248	Illegal power section configuration	-	●	●
249	Temperature of the rectifier heat sink	●	-	-
250	New spare part	-	-	●

Number	Description	Warning	Alarm	Alarm, trip lock
251	New type code	-	●	●
274	The flow is not confirmed	-	●	-
275	Flow switch failure	-	●	-
2004	External fault	-	●	-
2007	Too high bearing temperature	●	●	
2008	Too high bearing temperature	●	●	-
2010	Setpoint signal outside range	-	●	-
2011	Sensor 1 is outside range	-	●	-
2012	Sensor 2 is outside range	-	●	-
2013	Temperature sensor 1 is outside range	-	●	-
2014	Temperature sensor 2 is outside range	-	●	-
2016	Limit 1 is exceeded	●	●	-
2017	Limit 2 is exceeded	●	●	-

(●)This warning or alarm is programmable. Warnings and alarms depend on the parameter settings.

1 This warning or alarm cannot be auto reset via parameter selection.

13. Technical data

13.1 Enclosure

The individual CUE cabinet sizes are characterized by their enclosures. The table shows the relationship of enclosure class and enclosure type.

Example:

Read from the nameplate:

- Supply voltage = 3 x 380-500 V.
- Typical shaft power = 1.5 kW (2 hp).
- Enclosure class = IP20.

The table shows that the CUE enclosure is A2.

Typical shaft power P2		Enclosure										
		1 x 200-240 V			3 x 200-240 V		3 x 380-500 V		3 x 525-600 V		3 x 525-690 V	
[kW]	[hp]	IP20	IP21	IP55	IP20	IP55	IP20	IP55	IP20	IP55	IP21	IP55
0.55	0.75						A2	A4				
0.75	1				A2	A4			A3	A5		
1.1	1.5	A3		A5								
1.5	2		B1	B1								
2.2	3											
3	4				A3	A5						
3.7	5											
4	5						A2	A4	A3	A5		
5.5	7.5		B1	B1	B3	B1	A3	A5				
7.5	10		B2	B2								
11	15						B3	B1			B2	B2
15	20				B4	B2						
18.5	25					C1						
22	30				C3		B4	B2				
30	40											
37	50				C4	C2		C1			C2	C2
45	60						C3					
55	75											
75	100						C4	C2				
90	125											

13.2 Operating conditions

Relative humidity	5-95 % RH
Ambient temperature	Max. 50 °C (122 °F)
Average ambient temperature over 24 hours	Max. 45 °C (113 °F)
Minimum ambient temperature at full operation	0 °C (32 °F)
Minimum ambient temperature at reduced operation	-10 °C (14 °F)
Temperature during storage and transport	-25 to 65 °C (-13 to 149 °F)
Storage duration	Max. 6 months
Maximum altitude above sea level without performance reduction	1000 m (3280 ft)
Maximum altitude above sea level with performance reduction	3000 m (9840 ft)

CUE comes in a packaging which is not suitable for outdoor storage.

13.3 Mechanical data

13.3.1 Cable gland

Select standard gland holes for CUE frequency converters used outside USA and Canada.

Select imperial gland holes for CUE frequency converters used inside USA and Canada.

Enclosure	Standard gland holes	Imperial gland holes
A3 IP20/21 / NEMA type 1	3 x 22.5 (1/2")	3 x 22.5 (1/2")
	3 x 28.4 (3/4")	3 x 28.4 (3/4")
A4 IP55 / NEMA type 12	1 x 22.5 (1/2")	1 x 22.5 (1/2")
	3 x 28.4 (3/4")	3 x 28.4 (3/4")
A5 IP55 / NEMA type 12	6 x 26.3	6 x 28.4 (3/4")
B1 IP21 / NEMA type 1	2 x 22.5 (1/2")	2 x 22.5 (1/2")
	3 x 37.2	3 x 34.7 (1")
B1 IP55 / NEMA type 12	2 x 21.5	2 x 22.5 (1/2")
	1 x 26.3	1 x 28.4 (3/4")
	3 x 33.1	3 x 34.7 (1")
B2 IP21 / NEMA type 1 and B2 IP55 / NEMA type 12	1 x 21.5	1 x 22.5 (1/2")
	1 x 26.3	1 x 28.4 (3/4")
	1 x 33.1	1 x 34.7 (1")
	2 x 42.9	2 x 44.2 (1 1/4")

13.3.2 Cable requirements

Maximum length, screened motor cable	150 m (500 ft)
Maximum length, unscreened motor cable	300 m (1000 ft)
Maximum length, signal cable	300 m (1000 ft)

Always comply with local regulations as to cable cross-sections.

13.3.3 Cable cross-section to signal terminals

Maximum cable cross-section to signal terminals, rigid conductor	1.5 mm^2 (14 AWG)
Maximum cable cross-section to signal terminals, flexible conductor	1.0 mm^2 (18 AWG)
Minimum cable cross-section to signal terminals	0.5 mm^2 (20 AWG)

13.3.4 Non-UL fuses and conductor cross-section to mains and motor, for installations outside North America

Typical shaft power P2	Maximum fuse size	Fuse type	Maximum conductor cross-section[1)]
[kW (hp)]	[A]		[mm^2]
1 x 200-240 V			
1.1 (1.5)	20	gG	4
1.5 (2)	30	gG	10
2.2 (3)	40	gG	10
3 (4)	40	gG	10
3.7 (5)	60	gG	10
5.5 (7.5)	80	gG	10
7.5 (10)	100	gG	35
3 x 200-240 V			
0.75 (1)	10	gG	4
1.1 (1.5)	20	gG	4
1.5 (2)	20	gG	4
2.2 (3)	20	gG	4
3 (4)	32	gG	4
3.7 (5)	32	gG	4
5.5 (7.5)	63	gG	10
7.5 (10)	63	gG	10
11 (15)	63	gG	10
15 (20)	80	gG	35
18.5 (25)	125	gG	50
22 (30)	125	gG	50
30 (40)	160	gG	50
37 (50)	200	aR	95
45 (60)	250	aR	120
3 x 380-500 V			
0.55 (0.75)	10	gG	4
0.75 (1)	10	gG	4
1.1 (1.5)	10	gG	4
1.5 (2)	10	gG	4
2.2 (3)	20	gG	4
3 (4)	20	gG	4
4 (5)	20	gG	4
5.5 (7.5)	32	gG	4
7.5 (10)	32	gG	4
11 (15)	63	gG	10
15 (20)	63	gG	10
18.5 (25)	63	gG	10
22 (30)	63	gG	35
30 (40)	80	gG	35
37 (50)	100	gG	50
45 (60)	125	gG	50
55 (75)	160	gG	50
75 (100)	250	aR	95
90 (125)	250	aR	120
110 (150)	300	gG	2 × 70
132 (200)	350	gG	2 × 70
160 (250)	400	gG	2 × 185
200 (300)	500	gG	2 × 185
250 (350)	600	gR	2 × 185
3 x 525-600 V			
0.75 (1)	10	gG	4
1.1 (1.5)	10	gG	4
1.5 (2)	10	gG	4
2.2 (3)	20	gG	4
3 (4)	20	gG	4
4 (5)	20	gG	4
5.5 (7.5)	32	gG	4
7.5 (10)	32	gG	4
3 x 525-690 V			
11 (15)	63	gG	35
15 (20)	63	gG	35
18.5 (25)	63	gG	35
22 (30)	63	gG	35
30 (40)	63	gG	35
37 (50)	80	gG	95
45 (60)	100	gG	95
55 (75)	125	gG	95
75 (100)	160	gG	95
90 (125)	160	gG	95
110 (150)	225	-	2 × 70
132 (200)	250	-	2 × 70
160 (250)	350	-	2 × 70
200 (300)	400	-	2 × 185
250 (350)	500	-	2 × 185

1) Screened motor cable, unscreened supply cable. AWG. See section *13.3.5 UL fuses and conductor cross-section to mains and motor, for installations in North America*.

13.3.5 UL fuses and conductor cross-section to mains and motor, for installations in North America

Typical shaft power P2	Fuse type							Maximum conductor cross-section[1]
[kW (hp)]	Bussmann RK1/E1958/ JFHR2	Bussmann J/E4273 T/ JDDZ	Bussmann T/E4274 H/ JDDZ	SIBA RK1/ Bussmann E125085 JFHR2	Littel Fuse RK1/SIBA E180276 RKI/JDDZ	Ferraz-Shawmut CC/Littel Fuse E71611 JFHR2	Ferraz-Shawmut RK1/E60314 JFHR2	[AWG][2]
1 x 200-240 V								
1.1 (1.5)	KTN-R20	-	-	-	-	-	-	10
1.5 (2)	KTN-R30	-	-	-	-	-	-	7
2.2 (3)	KTN-R40	-	-	-	-	-	-	7
3 (4)	KTN-R40	-	-	-	-	-	-	7
3.7 (5)	KTN-R60	-	-	-	-	-	-	7
5.5 (7.5)	-	-	-	-	-	-	-	7
7.5 (10)	-	-	-	-	-	-	-	2
3 x 200-240 V								
0.75 (1)	KTN-R10	JKS-10	JJN-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1 (1.5)	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
1.5 (2)	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
2.2 (3)	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3 (4)	KTN-R30	JKS-30	JJN-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
3.7 (5)	KTN-R30	JKS-30	JJN-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
5.5 (7.5)	KTN-R50	JKS-50	JJN-50	5012406-050	KLN-R50	-	A2K-50R	7
7.5 (10)	KTN-R50	JKS-60	JJN-60	5012406-050	KLN-R60	-	A2K-50R	7
11 (15)	KTN-R60	JKS-60	JJN-60	5014006-063	KLN-R60	A2K-60R	A2K-60R	7
15 (20)	KTN-R80	JKS-80	JJN-80	5014006-080	KLN-R80	A2K-80R	A2K-80R	2
18.5 (25)	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R	1/0
22 (30)	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R	1/0
30 (40)	FWX-150	-	-	2028220-150	L25S-150	A25X-150	A25X-150	1/0
37 (50)	FWX-200	-	-	2028220-200	L25S-200	A25X-200	A25X-200	4/0
45 (60)	FWX-250	-	-	2028220-250	L25S-250	A25X-250	A25X-250	250 MCM
3 x 380-500 V								
0.55 (0.75)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
0.75 (1)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1 (1.5)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.5 (2)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
2.2 (3)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3 (4)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
4 (5)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
5.5 (7.5)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
7.5 (10)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
11 (15)	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R	7
15 (20)	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R	7
18.5 (25)	KTS-R50	JKS-50	JJS-50	5014006-050	KLS-R50	-	A6K-50R	7
22 (30)	KTS-R60	JKS-60	JJS-60	5014006-063	KLS-R60	-	A6K-60R	2
30 (40)	KTS-R80	JKS-80	JJS-80	2028220-100	KLS-R80	-	A6K-80R	2
37 (50)	KTS-R100	JKS-100	JJS-100	2028220-125	KLS-R100	-	A6K-100R	1/0
45 (60)	KTS-R125	JKS-150	JJS-150	2028220-125	KLS-R125	-	A6K-125R	1/0
55 (75)	KTS-R150	JKS-150	JJS-150	2028220-160	KLS-R150	-	A6K-150R	1/0
75 (100)	FWH-220	-	-	2028220-200	L50S-225	-	A50-P225	4/0
90 (125)	FWH-250	-	-	2028220-250	L50S-250	-	A50-P250	250 MCM
110 (150)	FWH-300	JJS-300	NOS-300	170M3017	2028220-38	L50S-300	A50-P300	2 x 2/0
132 (200)	FWH-350	JJS-350	NOS-350	170M3018	2028220-38	L50S-350	A50-P350	2 x 2/0
160 (250)	FWH-400	JJS-400	NOS-400	170M4012	206xx32-400	L50S-400	A50-P400	2 x 350 MCM
200 (300)	FWH-500	JJS-500	NOS-500	170M4014	206xx32-500	L50S-500	A50-P500	2 x 350 MCM
250 (350)	FWH-600	JJS-600	NOS-600	170M4016	206xx32-600	L50S-600	A50-P600	2 x 350 MCM
-	-	-	-	Bussmann E125085 JFHR2	SIBA E180276 JFHR2	-	Ferraz-Shawmut E76491 JFHR2	-

Typical shaft power P2	Fuse type							Maximum conductor cross-section[1]
[kW (hp)]	Bussmann RK1/E1958/ JFHR2	Bussmann J/E4273 T/ JDDZ	Bussmann T/E4274 H/ JDDZ	SIBA RK1/ Bussmann E125085 JFHR2	Littel Fuse RK1/SIBA E180276 RKI/JDDZ	Ferraz-Shawmut CC/Littel Fuse E71611 JFHR2	Ferraz-Shawmut RK1/E60314 JFHR2	[AWG][2]
3 x 525-600 V								
0.75 (1)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1 (1.5)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.5 (2)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
2.2 (3)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3 (4)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
4 (5)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
5.5 (7.5)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
7.5 (10)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
3 x 525-690 V								
11 (15)	KTS-R-25	JKS-25	JJS-25	5017906-025	KLSR025	HST25	A6K-25R	1/0
15 (20)	KTS-R-30	JKS-30	JJS-30	5017906-030	KLSR030	HST30	A6K-30R	1/0
18.5 (25)	KTS-R-45	JKS-45	JJS-45	5014006-050	KLSR045	HST45	A6K-45R	1/0
22 (30)	KTS-R-45	JKS-45	JJS-45	5014006-050	KLSR045	HST45	A6K-45R	1/0
30 (40)	KTS-R-60	JKS-60	JJS-60	5014006-063	KLSR060	HST60	A6K-60R	1/0
37 (50)	KTS-R-80	JKS-80	JJS-80	5014006-080	KLSR075	HST80	A6K-80R	1/0
45 (60)	KTS-R-90	JKS-90	JJS-90	5014006-100	KLSR090	HST90	A6K-90R	1/0
55 (75)	KTS-R-100	JKS-100	JJS-100	5014006-100	KLSR100	HST100	A6K-100R	1/0
75 (100)	KTS-R125	JKS-125	JJS-125	2028220-125	KLS-125	HST125	A6K-125R	1/0
90 (125)	KTS-R150	JKS-150	JJS-150	2028220-150	KLS-150	HST150	A6K-150R	1/0
110 (150)	-	-	-	170M3017	2061032.38	-	6.6URD30D08A038	2 x 2/0
132 (200)	-	-	-	170M3018	2061032.350	-	6.6URD30D08A0350	2 x 2/0
160 (250)	-	-	-	170M4011	2061032.350	-	6.6URD30D08A0350	2 x 2/0
200 (300)	-	-	-	170M4012	2061032.350	-	6.6URD30D08A0400	2 x 350 MCM
250 (350)	-	-	-	170M4014	2061032.500	-	6.6URD30D08A0500	2 x 350 MCM

1 Screened motor cable, unscreened supply cable.

2 American Wire Gauge.

13.4 Electrical data

Mains supply (L1, L2, L3)

Supply voltage	200-240 V ± 10 %
Supply voltage	380-500 V ± 10 %
Supply voltage	525-600 V ± 10 %
Supply voltage	525-690 V ± 10 %
Supply frequency	50/60 Hz
Maximum temporary imbalance between phases	3 % of rated value
Leakage current to protective earth	> 3.5 mA
Number of cut-ins, enclosure A	Max. 2 times/min.
Number of cut-ins, enclosures B and C	Max. 1 time/min.

Do not use the power supply for switching CUE on and off.

Motor output (U, V, W)

Output voltage	0-100 %[1)]
Output frequency	0-590 Hz[2)]
Switching on output	Not recommended

1) Output voltage in percentage of supply voltage.

2) Depending on the pump family selected.

RS-485 GENIbus connection

Terminal number	68 (A), 69 (B), 61 GND (Y)

The RS-485 circuit is functionally separated from other central circuits and galvanically separated from the supply voltage (PELV).

Digital inputs

Terminal number	18, 19, 32, 33
Voltage level	0-24 VDC
Voltage level, open contact	> 19 VDC
Voltage level, closed contact	< 14 VDC
Maximum voltage on input	28 VDC
Input resistance, R_i	Approx. 4 kΩ

All digital inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

Signal relays

Relay 01, terminal number	1 (C), 2 (NO), 3 (NC)
Relay 02, terminal number	4 (C), 5 (NO), 6 (NC)
Maximum terminal load (AC-1)[1)]	240 VAC, 2 A
Maximum terminal load (AC-15)[1)]	240 VAC, 0.2 A
Maximum terminal load (DC-1)[1)]	50 VDC, 1 A
Minimum terminal load	24 VDC 10 mA 24 VAC 20 mA

1) IEC 60947, parts 4 and 5.

C Common

NO Normally open

NC Normally closed

The relay contacts are galvanically separated from other circuits by reinforced insulation (PELV).

Analog inputs

Analog input 1, terminal number	53
Voltage signal	A53 = "U"[1)]
Voltage range	0-10 V
Input resistance, R_i	Approx. 10 kΩ
Maximum voltage	± 20 V
Current signal	A53 = "I"[1)]
Current range	0-20, 4-20 mA
Input resistance, R_i	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale
Analog input 2, terminal number	54
Current signal	A54 = "I"[1)]
Current range	0-20, 4-20 mA
Input resistance, R_i	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale

1) The factory setting is voltage signal "U".

All analog inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

Analog output

Analog output 1, terminal number	42
Current range	0-20 mA
Maximum load to frame	500 Ω
Maximum fault	0.8 % of full scale

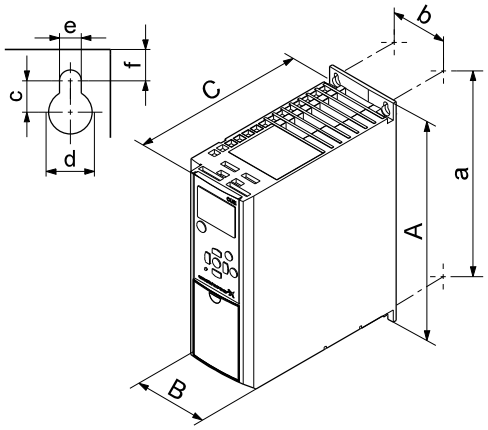
The analog output is galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

MCB 114 sensor input module

Analog input 3, terminal number	2
Current range	0/4-20 mA
Input resistance	< 200 Ω
Analog inputs 4 and 5, terminal number	4, 5 and 7, 8
Signal type, 2- or 3-wire	Pt100/Pt1000

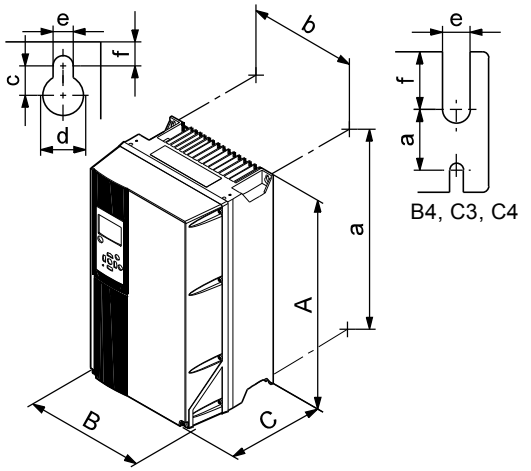
13.5 Dimensions and weights

13.5.1 Enclosures A2-A5, B1-B4 and C1-C4.



TM03 9000 2807

Fig. 52 Dimensions for enclosures A2 and A3



TM03 9002 2807

Fig. 53 Dimensions for enclosures A4, A5, B1, B2, B3, B4, C1, C2, C3 and C4

Enclosure	Height [mm][1)]		Width [mm][1)]		Depth [mm][1)]		Screw holes [mm]				Weight [kg]
	A	a	B	b	C	C	c	Ød	Øe	f	
A2	268	257	90	70	205	219	8	11	5.5	9	4.9
IP21/NEMA1	375	350	90	70	205	219	8	11	5.5	9	5.3
A3	268	257	130	110	205	219	8	11	5.5	9	6.6
IP21/NEMA1	375	350	130	110	205	219	8	11	5.5	9	7
A4	420	401	200	171	175	175	8.2	12	6.5	6	9.2
A5	420	402	242	215	200	200	8.2	12	6.5	9	14
B1	480	454	242	210	260	260	12	19	9	9	23
B2	650	624	242	210	260	260	12	19	9	9	27
B3	399	380	165	140	248	262	8	12	6.8	7.9	12
IP21/NEMA1	475	-	165	-	249	262	8	12	6.8	7.9	-
B4	520	495	231	200	242	242	-	-	8.5	15	23.5
IP21/NEMA1	670	-	255	-	246	246	-	-	8.5	15	-
C1	680	648	308	272	310	310	12	19	9	9.8	45
C2	770	739	370	334	335	335	12	19	9	9.8	65
C3	550	521	308	270	333	333	-	-	8.5	17	35
IP21/NEMA1	755	-	329	-	337	337	-	-	8.5	17	-
C4	660	631	370	330	333	333	-	-	8.5	17	50
IP21/NEMA1	950	-	391	-	337	337	-	-	8.5	17	-

1) The dimensions are maximum height, width and depth.

13.5.2 Enclosures D1h and D2h

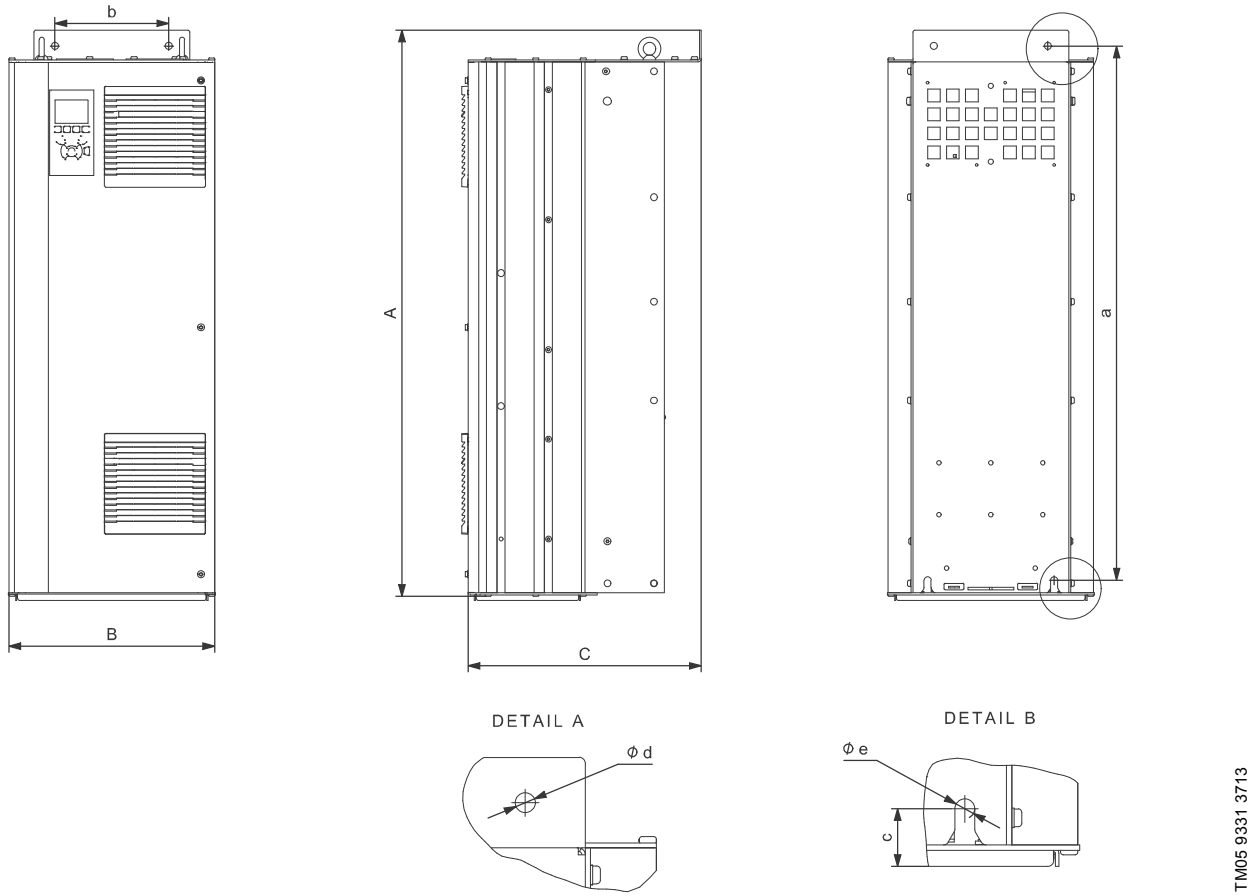


Fig. 54 Dimensions for enclosures D1h and D2h

Enclosure	Height [mm][1)]		Width [mm][1)]		Depth [mm][1)]	Screw holes [mm]				Weight [kg]
	A	a	B	b	C	c	Ød	Øe	f	
D1h	901	844	325	180	378	20	11	11	25	62
D2h	1107	1051	420	280	378	20	11	11	25	125

Shipping dimensions					
Enclosure	**Height [mm][1)]**	**Width [mm][1)]**	**Depth [mm][1)]**	**Weight [kg]**	
D1h	850	370	460	73	Only 3 x 380-500 V, 110 kW (150 hp)
D1h	850	370	460	72 - 124.5	
D2h	1190	560	640	18 - 125.5	

1) The dimensions are maximum height, width and depth.

13.6 Miscellaneous data

13.6.1 Sound pressure level

The sound pressure of CUE is maximum 70 dB(A).

The sound pressure level of a motor controlled by a frequency converter may be higher than that of a corresponding motor which is not controlled by a frequency converter. See section *7.3 RFI filters*.

13.6.2 STO application

The STO signal must be SELV or PELV supplied.

European directive	Machinery Directive (2006/42/EC)	EN ISO 13849-1
		EN IEC 62061
		EN IEC 61800-5-2
	EMC Directive (2004/108/EC)	EN 50011
		EN 61000-6-3
		EN 61800-3
	Low Voltage Directive (2006/95/EC)	EN 50178
		EN 61800-5-1
Safety standards	Safety of machinery	EN ISO 13849-1, IEC 62061, IEC 60204-1
	Functional safety	IEC 61508-1 to -7, IEC 61800-5-2
Safety function		IEC 61800-5-2 (Safe Torque Off, STO) IEC 60204-1 (Stop Category 0)
Safety performance	**IOS 13849-1**	
	Category	Cat 3
	Diagnostic Coverage	DC: 90 %, medium
	Mean Time to Dangerous Failure	MTTFd: 14000 years, high
	Performance Level	PL d
	IEC 61508 / IEC 62061	
	Safety Integrity Level	SIL 2, SIL CL2
	Probability of Dangerous Failure per Hour	PFH: 1E-10/h. High Demand Mode.
	Probability of Dangerous Failure on Demand	PFD: 1E-10. Low Demand Mode.
	Safe Failure Fraction	SFF: > 99 %
	Hardware Fault Tolerance	HFT: 0 (1oo1)
	Proof Test Interval T1	20 years
	Mission time TM	20 years
Reaction time	Input to output response time	Maximum 20 ms

14. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

The crossed-out wheelie bin symbol on a product means that it must be disposed of separately from household waste. When a product marked with this symbol reaches its end of life, take it to a collection point designated by the local waste disposal authorities. The separate collection and recycling of such products will help protect the environment and human health.

See also end-of-life information at www.grundfos.com/product-recycling.

USA
GRUNDFOS Chicago
3905 Enterprise Court
P.O. Box 6620
Aurora, IL 60598-0620
Phone: +1-630-236-5500
Fax: +1-630-236-5511

GRUNDFOS Kansas City
9300 Loiret Blvd.
Lenexa, Kansas 66219
Phone: +1-913-227-3400
Fax: +1-913-227-3500

www.grundfos.us

Canada
GRUNDFOS Canada
2941 Brighton Road
Oakville, Ontario L6H 6C9 Canada
Phone: +1-905 829 9533
Fax: +1-905 829 9512

www.grundfos.ca

México
GRUNDFOS México
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
C.P. 66600 Apodaca, N.L Mexico
Phone: +011-52-81-8144 4000
Fax: +011-52-81-8144 4010

www.grundfos.mx

99735239 0919
ECM: 1269700

UTILITY ADVISORY COMMISSION STAFF REPORT **DISCUSSION ITEM #1**
MEETING DATE: **APRIL 1, 2021**
STAFF CONTACT: **GONZALO GARCIA, UTILITIES DIRECTOR**

AGENDA ITEM: Project Updates

Background:

Staff will discuss current developments of projects.